U.S. DEPARTMENT OF COMMERCE
National Technical Information Service

PB-269 667

Methods Used to Estimate Air Pollutant Emissions 1974, 1980, 1985, and 2000 - New Jersey - New York Connecticut Air Quality Control Region

Tri-State Regional Planning Commission, New York

Prepared for

Environmental Protection Agency, New York. Region II

May 77

EPA-902/4-77–006

PB 269 667

METHODS USED TO ESTIMATE AIR POLLUTANT EMISSIONS

1974, 1980, 1985 AND 2000

NEW JERSEY - NEW YORK - CONNECTICUT
AIR QUALITY CONTROL REGION

JUNE 1977

FINAL REPORT

REPRODUCED BY
NATIONAL TECHNICAL
INFORMATION SERVICE
U. S. DEPARTMENT OF COMMERCE
SPRINGFIELD, VA. 22161

US ENVIRONMENTAL PROTECTION AGENCY
REGION II

TECHNICAL REPORT DATA

(Please read Instructions on the reverse before completing)

1. REPORT NO.
EPA-902/4-77-006

2.

3. RECIPIENT'S ACCESSION NO.

4. TITLE AND SUBTITLE
METHODS USED TO ESTIMATE AIR POLLUTANT EMISSIONS
1974, 1980, 1985 and 2000
NEW JERSEY - NEW YORK - CONNECTICUT
AIR QUALITY CONTROL REGION

5. REPORT DATE
May 1977

6. PERFORMING ORGANIZATION CODE
R-572

7. AUTHOR(S)
Jocelyn M. Bishop, Paul M. Nutkowitz PhD, Hall Winslow

8. PERFORMING ORGANIZATION REPORT NO.
R-572 Method Report

9. PERFORMING ORGANIZATION NAME AND ADDRESS
Tri-State Regional Planning Commission
1 World Trade Center - 82d floor
New York City N.Y. 10048

10. PROGRAM ELEMENT NO.

11. CONTRACT/GRANT NO.
EPA 68-02-2096

12. SPONSORING AGENCY NAME AND ADDRESS
U.S. Environmental Protection Agency
Region II
26 Federal Plaza
New York, NY 10007

13. TYPE OF REPORT AND PERIOD COVERED
Final Method Report

14. SPONSORING AGENCY CODE

15. SUPPLEMENTARY NOTES
Prepared in cooperation with the air resources planning staffs of the environmental protection departments of Connecticut, New Jersey and New York and of Region II, Environmental Protection Agency.

16. ABSTRACT

An explanation of methods, procedures and data inputs used in calculating air pollutant emissions for subsequent dispersion modelling. Arranged by area sources and point sources, withinstate portions and New York City. Shows data deficiencies and modifications of methods necessary in an 8500-sq.mi. 3-state region. Demonstrates how the extensive land use and transportation planning resources of an interstate metropolitan planning agency can be used in estimating emissions.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group

18. DISTRIBUTION STATEMENT

19. SECURITY CLASS *(This Report)*

20. SECURITY CLASS *(This page)*

21. NO. OF PAGES
237

22. PRICE
PC A11 · A01

EPA Form 2220-1 (9-73)

This air pollution report is issued by Region II, Environmental Protection Agency, to assist state and local air pollution control agencies in carrying out their program activities. Copies of this report may be obtained, for a nominal cost, from the National Technical Information Service, 5285 Port Royal Road, Springfield, Virginia 22151.

This report was furnished by the Environmental Protection Agency by Tri-State Regional Planning Commission (Conn/N.J./N.Y.) in partial fulfillment of EPA-902/4-77-006. This report has been reviewed by Air Branch, Region II, EPA, and approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the Environmental Protection Agency, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

Region II Publication No. EPA-902/4-77-006

EPA-902/4-77-006

METHODS USED TO ESTIMATE AIR POLLUTANT EMISSIONS

1974, 1980, 1985, and 2000

NEW JERSEY - NEW YORK - CONNECTICUT

AIR QUALITY CONTROL REGION

Tri-State Regional Planning Commission
One World Trade Center
New York, New York 10048

EPA Contract No.: 68-02-2096

EPA Project Officer: Dr. George Kerr

Prepared for

ENVIRONMENTAL PROTECTION AGENCY
Research Triangle Park, N. C. 27711

CONTENTS

INTRODUCTION

AREA SOURCES

A 1 Residential Fuel Combustion
  A 1-a Natural Gas
  A 1-b Distillate Oil
  A 1-c Residual Oil

A 2 Commercial and Institutional Fuel Combustion
  A 2-a Natural Gas
  A 2-b Distillate Oil
  A 2-c Residual Oil
A 3 Industrial Fuel Combustion
  A 3-a Natural Gas
  A 3-b Distillate Oil
  A 3-c Residual Oil

A 4 Onsite Incineration

A 6 Diesel Locomotives

A 7 Vessels

A 8 Aircraft

A 9-a Gasoline and Diesel Fuel - Highway
A 9-b(i) Gasoline - Offhighway
A 9-b(ii) Diesel - Offhighway

CONTENTS - continued

A 10 Evaporation - Solvents

A 10-a Evaporation - Gasoline Marketing

A 11 Apartment Construction Dust

POINT SOURCES

P 1 Electric Power Plants

P 2 Industrial Process Fuel Combustion (incl. Area Sources)

P 3 Municipal Incinerators

P 4 Point Source Fuel Combustion

APPENDIX

I Metric Conversion of Land Use Files

II List of Supplementary Studies

III List of Tables Produced

IV Method of Estimating Housing Units

V Method of Estimating Employment

VI Statewide Fuel Balance Calculations for 1974, New York State

INTRODUCTION

The Tri-State Regional Planning Commission, as contractor to the Environmental Protection Agency, has prepared a comprehensive air pollutant emissions inventory for the NJ-NY-Conn. AQCR for the baseline calibration year of 1974 and the projection years of 1980, 1985, and 2000. This is the initial step in estimating the air pollution concentrations in this AQCR, which in turn will be used in the preparation of an Air Quality Maintenance Plan by the three states and New York City.

This report contains an explanation of the methods used in preparing the inventory. It is arranged by pollution source, and is divided into two main parts - area sources and point sources. Methods were based mainly on those set forth in

- Guide for Compiling a Comprehensive Emission Inventory - APTD-1135
- Guidelines for Air Quality Maintenance Planning and Analysis
    - Vol. 7 Projecting County Emissions
    - Vol. 13 Allocating Projected Emissions to Subcounty Areas.

Whenever different approaches are used, reasons for the choices are set forth.

The work involved the use of Tri-State's land development data resources and inventory methods, its travel demand models and computerized highway inventories, economic growth projections, a citizens housing survey, and selected other inventories. See Appendix II - List of Supplementary Studies and Appendix IV - Method of Estimating Housing Units.

Other products of this inventory activity consist of updated NEDS files, report tables listed in Guidelines, Vols. 7 and 13 (some of which are presented in computer printout format), and the various computer tapes showing allocation of pollutant emissions by square kilometer.

As a major foundation for the area source pollution emissions,Tri-State has provided a tape file and printout of the land use parameters for projection years. The land use categories are:

Population
Employment
Total Housing Units
Occupied Housing Units
Residential Floorspace
Residential Land Area
Non-Residential Floorspace
Non-Residential Land Area
Other Land Area

Owing to differences in data supplied by the three states and by New York City and necessary variations in methods, several of the method reports are divided into four sections. These are for areas as follows:

- the nine counties of Northeast New Jersey
- the seven New York suburban counties
- New York City itself
- Fairfield County in Connecticut.

Explanations are hinged on the work diagrams for the respective sources. To avoid duplication in and padding of the report, the work diagrams carry notations on tables produced and on data sources. Where other detail or discussion of method choices are needed, they are provided in the narrative accompanying the diagrams.

Although emissions from Ulster County are included in the scope of this contract, they are to be calculated by New York Department of Environmental Conservation, as covered in a letter from the Project Officer dated May 1977.

A 1a NATURAL GAS - RESIDENTIAL

Update Level: 3 [pp 79-82, Guidelines, Vol. 7]
Projection Level: 3 [pp 136-139, Guidelines, Vol. 7]
Allocation Order: 3 [pp 31-38, Guidelines, Vol. 13]

Substance and sequence of steps are given in the work chart. The following details are provided for those steps where procedures are not obvious.

NEW JERSEY

Step 1

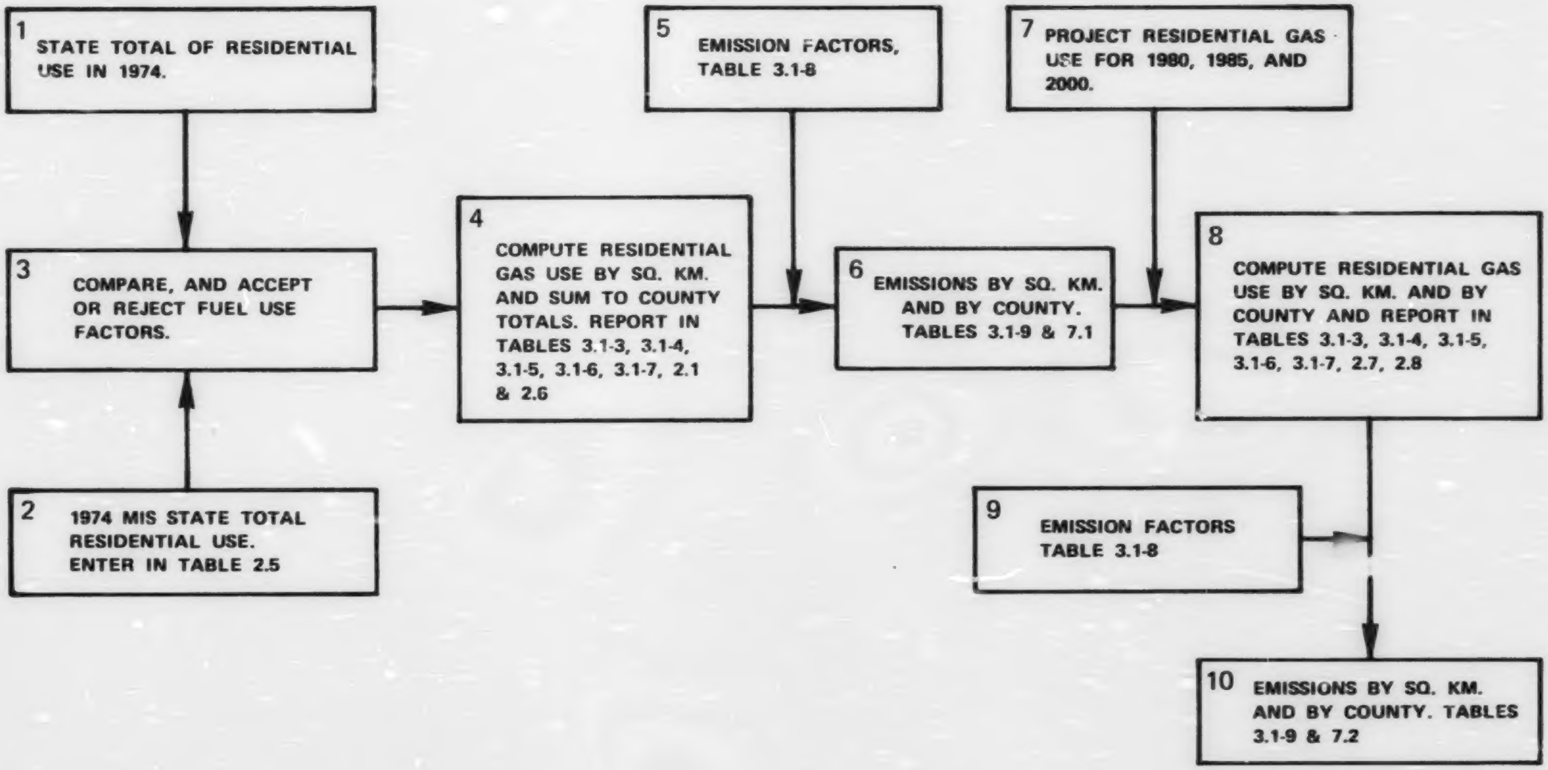
The state total of residential natural gas use, A, was estimated by the formula

$$A = \sum_{i=1}^{4} B_i \times F_i \times H \times C \times FUF_i$$

A1a NATURAL GAS – RESIDENTIAL

(AREA SOURCE)

LEVEL: 3
ORDER: 3


1 STATE TOTAL OF RESIDENTIAL USE IN 1974.
2 1974 MIS STATE TOTAL RESIDENTIAL USE. ENTER IN TABLE 2.5
3 COMPARE, AND ACCEPT OR REJECT FUEL USE FACTORS.
4 COMPUTE RESIDENTIAL GAS USE BY SQ. KM. AND SUM TO COUNTY TOTALS. REPORT IN TABLES 3.1-3, 3.1-4, 3.1-5, 3.1-6, 3.1-7, 2.1 & 2.6
5 EMISSION FACTORS, TABLE 3.1-8
6 EMISSIONS BY SQ. KM. AND BY COUNTY. TABLES 3.1-9 & 7.1
7 PROJECT RESIDENTIAL GAS USE FOR 1980, 1985, AND 2000.
8 COMPUTE RESIDENTIAL GAS USE BY SQ. KM. AND BY COUNTY AND REPORT IN TABLES 3.1-3, 3.1-4, 3.1-5, 3.1-6, 3.1-7, 2.7, 2.8
9 EMISSION FACTORS TABLE 3.1-8
10 EMISSIONS BY SQ. KM. AND BY COUNTY. TABLES 3.1-9 & 7.2

New Jersey cont.

where B_i = the state total of dwelling units in building size i (i = 1, 1 d.u./bldg.; i = 2, 2 to 4 du's/bldg.; i = 3, 5 to 19 du's/bldg., i = 4, 20+ du's/bldg.) Source: See Appendix IV

F_i = the fraction of dwelling units using natural gas for space heating in building size i

H = state average, annual heating degree days (hdd)

C = correction factor; state average, rooms per dwelling unit/5.0

FUF_i = fuel use factor for dwelling units in building size i (ft. 3/du-hdd)

The values used are listed in the matrix below:

i	B_i	F_i	H	C	FUF_i	A (cu. ft.)
1	1,380,095	0.619	5000	1.04	26.6	$118,163.\text{x}10^6$
2	503,749	0.378	5000	1.04	23.9	$23,665.\text{x}10^6$
3	269,877	0.308	5000	1.04	18.4	$7,953.\text{x}10^6$
4	229,977	0.000	5000	1.04	12.4	0.
Total	2,383,698					$149,781.\text{x}10^6$

Step 2

MIS = $135,843.\text{x}10^6$ cu. ft.

Step 3

Since the estimate in Step 1 is 10% higher than MIS, but is obtained by estimating a crude value of H, it was decided to use the FUF_i's as given in Step 1.

New Jersey cont.

Step 4

The quantity of natural gas used for space heating in square kilometer j, A_j, was estimated using the formula:

$$A_j = \sum_{i=1}^{4} B_{ij} \times Fi \times C \times D_j \times FUF_i$$

where B_{ij} = The number of dwelling units in building size i in square kilometer j (i = 1, 1 du/bldg; i = 2, 2 to 4 du's/bldg, i = 3, 5 to 19 du's/bldg; i = 4, 20+ du's/bldg)

F_i = The fraction of dwelling units using natural gas in building size i (F_i = 0.619, F_i = 0.378, F_i = 0.308, F_i = 0.00)

C = correction factor, county average, rooms per du/5.0

D_j = heating degree days in square kilometer j

FUF_i = fuel use factor (ft ^{3}/du - hdd) for dwelling units in building size i

The B_{ij} were estimated by Tri-State (see Appendix IV), the F_i were derived from Tri-State's "Housing and Neighborhood Survey," and the FUF_i from Guidelines, Vol. 13. The sum of the products $B_{ij} \times F_i$ for each square kilometer were scaled by using a pseudo control number derived from 1970 Census data and Tri-State's 1974 land use files.

New Jersey cont.

Step 5

EMISSION FACTORS FOR RESIDENTIAL NATURAL GAS COMBUSTION

POLLUTANT	$lb/10^6$ CU. FT.
Particulates	10.0
Sulfur Oxides	0.6
Nitrogen Oxides	80
Hydrocarbons	8
Carbon Monoxide	20

Source: AP-42

Step 7

For projection years it is assumed that there will be little or no additional natural gas supplied to this Region. This scenario is based upon analyses performed by the Federal Energy Administration and reported in "National Energy Outlook," February, 1976. While the above assumption is probably reasonable over the period 1974 to 1985, the long term forecast may be altered by the resolution of transportation of Alaska gas to the lower-48, and/or East Coast OCS activity.

NEW YORK CITY

Steps 1, 2 and 3

Omit

New York City cont.

Step 4

County totals of natural gas used for residential space heating were supplied by the New York City Department of Air Resources. These county totals were allocated to square kilometers using the following 3-step procedure:

A. County totals of the following four quantities were calculated:

y_1 (cu. ft.) = (no. of du's in 1 du/bldg using gas) (heating deg.-days) (26.6 ft 3/du-hdd)

y_2 (cu. ft.) = (no. of du's in 2-4 du/bldg using gas) (heating deg.-days)x (23.9 ft 3/du-hdd)

y_3 (cu. ft.) = (no. of du's in 5-19 du/bldg using gas) (heating deg.-days) x (18.4 ft 3/du-hdd)

y_4 (cu. ft.) = (no. of du's in 20+ du/bldg using gas) (heating deg.-days) x (12.4 ft 3/du-hdd)

B. i. The County total of gas used by du's in buildings with 1 du/bldg was was calculated from

$$y_1 = \text{(County total of residential gas use [supplied by NYCDAR])} \times \frac{y_1}{y_1 + y_2 + y_3 + y_4}$$

B. ii. The County total of gas used by du's in buildings with 2 to 4 du's/bldg was calculated from

$$y_2 = \text{(County total of residental gas use [supplied by NYCDAR])} \times \frac{y_2}{y_1 + Y_2 + Y_3 + Y_4}$$

B.iii. The County total of gas used by du's in buildings with 5 to 19 du's/bldg was calculated from

$$y_3 = \text{(County total of residential gas use [supplied by NYCDAR])} \times \frac{y_3}{y_1 + y_2 + y_3 + y_4}$$

B. iv. The County total of gas used by du's in buildings with 20 + du's/bldg was calculated from

$$y_4 = \text{(County total of residential gas use [supplied by NYCDAR])} \times \frac{y_4}{y_1 + y_2 + y_3 + y_4}$$

New York City cont.

C. Allocate county total Y_1 to square kilometers

$$\text{Gas used in sq. km. } j \text{ by du's in 1 du/bldg structures} = Y_1 \times \frac{\text{no. of du's using gas in 1 du/bldg structures in sq.km.}_j}{\text{no. of du's using gas in 1 du/bldg structures in county}}$$

$$\text{Gas used in sq. km. } j \text{ by du's in 2-4 du/bldg structures} = Y_2 \times \frac{\text{no. of du's using gas in 2-4 du/bldg structures in sq.km.}_j}{\text{no. of du's using gas in 2-4 du/bldg structures in county}}$$

etc.

See Appendix IV for source of dwelling units by building size.

Step 5

EMISSION FACTORS FOR RESIDENTIAL NATURAL GAS COMBUSTION

POLLUTANT	lb/10^6 CU. FT.
Particulates	6
Sulfur Oxides	0.6
Nitrogen Oxides	100
Hydrocarbons	4
Carbon Monoxide	20

Source: NYCDAR

Step 7

Same assumption as for New Jersey.

NEW YORK STATE (EXCL. NEW YORK CITY)

Steps 1 through 4

Total fuel use by fuel type by user class was calculated by New York Department of Environmental Conservation. See Appendix VI, Statewide Fuel Balance Calculations for 1974, New York State. No points were denoted Residential as such.

New York State cont.

Step 5

EMISSION FACTORS FOR RESIDENTIAL NATURAL GAS COMBUSTION

POLLUTANT	lb/10^6 CU. FT.
Particulates	10
Sulfur Oxides	0.6
Nitrogen Oxides	80
Hydrocarbons	8
Carbon Monoxide	20

Source: AP-42

CONNECTICUT (Fairfield County)

Steps 1, 2 and 3

Omit

Step 4

Residential natural gas use for 1974 by MCD was supplied by the CONNDEP. These numbers were allocated to square kilometers by the same methods used for New York City, with MCD data instead of county data.

Connecticut cont.

Step 5

EMISSION FACTORS FOR RESIDENTIAL NATURAL GAS COMBUSTION

POLLUTANT	lb/10^6 CU. FT.
Particulates	10.0
Sulfur Oxides	0.6
Nitrogen Oxides	80.0
Hydrocarbons	8.0
Carbon Monoxide	20.0

Source: AP-42

Step 7

Same assumptions as for New Jersey.

A 1b DISTILLATE OIL - RESIDENTIAL

Update Level: 2[pp. 62-63, Guidelines, Vol. 7]
Projection Level: 3 [pp. 136-137, Guidelines, Vol. 7]
Allocation Order: 3 [pp. 31-38, Guidelines, Vol. 13]

Substance and sequence of steps are given in the work chart. The following details are provided for those steps where procedures are not obvious.

NEW JERSEY

Step 1

Distillate oil use by square kilometer, A_j, and by county (9 counties of N.E.N.J.) was calculated using the equation

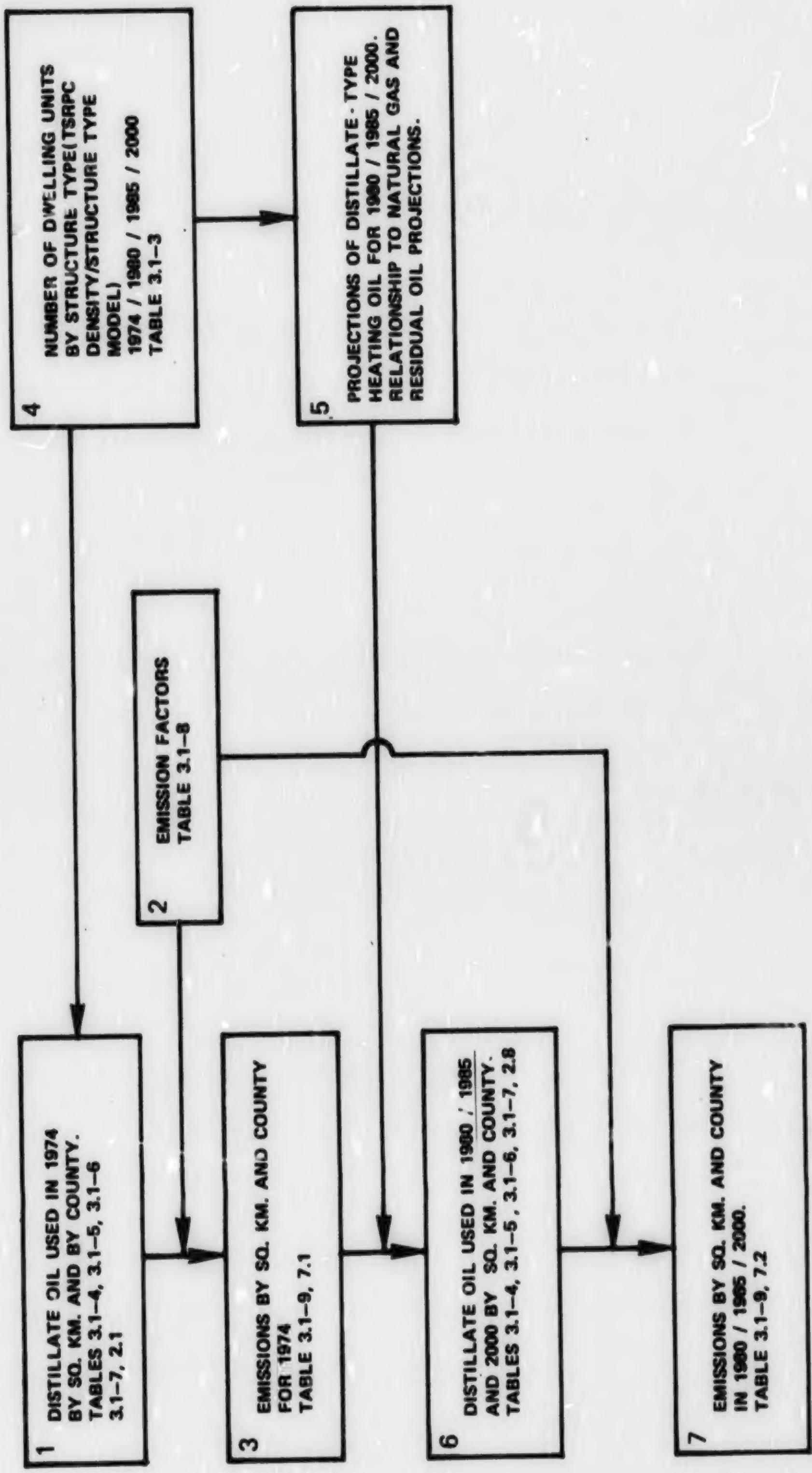
$$A_j = \sum_{i=1}^{2} B_{ij} \times F_i \times H_j \times C \times FUF_i$$

where B_{ij} = the number of dwelling units in type i structures (i = 1, 1 du/bldg.; i = 2, 2 to 4 du/bldg) in square kilometer j

Source: see Appendix IV

A 1b DISTILLATE OIL–RESIDENTIAL

(AREA SOURCE)


4
NUMBER OF DWELLING UNITS BY STRUCTURE TYPE(TSRPC DENSITY/STRUCTURE TYPE MODEL) 1974 / 1980 / 1985 / 2000 TABLE 3.1–3
5
PROJECTIONS OF DISTILLATE-TYPE HEATING OIL FOR 1980 / 1985 / 2000. RELATIONSHIP TO NATURAL GAS AND RESIDUAL OIL PROJECTIONS.
2
EMISSION FACTORS TABLE 3.1–8
1
DISTILLATE OIL USED IN 1974 BY SQ. KM. AND BY COUNTY. TABLES 3.1–4, 3.1–5, 3.1–6 3.1–7, 2.1
3
EMISSIONS BY SQ. KM. AND COUNTY FOR 1974 TABLE 3.1–9, 7.1
6
DISTILLATE OIL USED IN 1980 / 1985 AND 2000 BY SQ. KM. AND COUNTY. TABLES 3.1–4, 3.1–5, 3.1–6, 3.1–7, 2.8
7
EMISSIONS BY SQ. KM. AND COUNTY IN 1980 / 1985 / 2000. TABLE 3.1–9, 7.2

New Jersey cont.

F_i = The fraction of dwelling units using oil for space heating in type i structures (obtained from TSRPC "Housing and Neighborhood Survey) for New Jersey counties.

H_j = The number of heating degree days in square kilometer j

C = A correction factor (the county average number of rooms per dwelling unit, divided by 5)

FUF_i = The fuel use factor for dwelling units in type i structures (FUF_1 = 0.157 gals/du-hdd; FUF_2 = 0.142 gals/du-hdd)

The frequency distribution of distillate oil use as a function of building size was approximated by assuming that buildings with 5 or more dwelling units use only residual oil.

Step 2

EMISSION FACTORS FOR RESIDENTIAL DISTILLATE OIL COMBUSTION

Pollutant	$lb/10^3$ gal
Particulates	2.5
Sulfur Oxides	$142\ S^a = 28.4$
Nitrogen Oxides	20.
Hydrocarbons	1.0
Carbon Monoxide	5.0

a. S = 0.2

Source: AP-42

New Jersey cont.

Step 5

It is assumed that all future demand in space heating will be served by oil. This assumption can be derived from analysis performed by the FEA and reported in "National Energy Outlook, February 1976." This scenario is probably valid through 1985, with decreasing reliability thereafter. (See Appendix IV for assumptions regarding housing units by building size.)

NEW YORK CITY

Step 1

County totals of distillate oil were provided by the New York City Department of Air Resources. Methods used to develop these totals are described in a series of technical reports issued by the Bureau of Technical Services, DAR. Allocation of county totals to square kilometers was accomplished using the following method. The number of dwelling units using oil in square kilometer j in building size i, Nij, was estimated from the product

$$N_{ij} = N_{ij} \times F_i$$

where N_{ij} = the number of dwelling units in building size i (i = 1, 1 du/bldg; i = 2, 2 to 4 du's/bldg) in square kilometer j.

(Source: see Appendix IV)

F_i = the fraction of dwelling units using oil in building size i, (obtained from the TSRPC "Housing and Neighborhood Survey").

The frequency distribution of distillate oil use as a function of building size was approximated by assuming that distillate is used only in building sizes i

New York City cont. - Step 1

equal 1 and 2. Then the distillate oil used in square kilometer j, A_j, is estimated from

$$A_j = C_T \times \frac{\sum_{i=1}^{2} N_{ij}}{\sum_{j=1}^{Z} \sum_{i=1}^{2} N_{ij}}$$

where C = County total distillate oil (supplied by NYCDAR)

Z = Total number of square kilometers in the county

Step 2

EMISSION FACTORS FOR RESIDENTIAL DISTILLATE OIL COMPUSTION

Pollutant	$lb/10^3$ Gal.
Particulates	2.5
Sulfur Oxides	$142\ S^{a} = 28.4$
Nitrogen Oxides	20.
Hydrocarbons	1.5
Carbon Monoxide	10.

a. S = .2

Source: New York City Dept. of Air Resources

Step 5

The same assumption as for New Jersey. See Appendix IV for source of housing units by building size.

NEW YORK STATE

Steps 1 through 4

Total fuel use by fuel type by user class was calculated by New York Department of Environmental Conservation. Residential distillate oil usage for each county was estimated by subtracting the point source usage from the total for that county. See Appendix VI, Statewide Fuel Balance Calculations for 1974, New York State.

New York State cont.

Step 2

EMISSION FACTORS FOR RESIDENTIAL DISTILLATE OIL COMBUSTION

	Rockland, Westchester, Nassau	(Western) Suffolk[b]	Eastern Suffolk[d] and Orange, Putnam, Dutchess
Pollutant	$lb/10^3$ gal	$lb/10^3$ gal	$lb/10^3$ gal
Particulates	2.5	2.5	2.5
Sulfur Oxides	142 S[a]=52.5	142 S[c]=142	142 S[e]=284
Nitrogen Oxides	18.0	18.0	18.0
Hydrocarbons	1.0	1.0	1.0
Carbon Monoxide	5.0	5.0	5.0

a. S = 0.37

b. Towns of Babylon, Brookhaven, Huntington, Islip, and Smithtown

c. S = 1.00

d. Towns of Easthampton, Riverhead, Shelter Island, Southampton, Southold

e. S = 2.00

Step 5

The same assumptions as for the New Jersey sector.

CONNECTICUT (Fairfield County)

Step 1

Distillate oil data were supplied by the Connecticut Department of Environmental Protection by MCD. Methods used to develop these data are described in Appendix A, Connecticut Air Inventory Reference (CONNAIR), Department of Environmental Protection, Air Compliance Unit, Engineering Section. Allocation to square kilometers was accomplished by the same methods used for New York City, but with MCD totals replacing county totals.

Step 2

EMISSION FACTORS FOR RESIDENTIAL DISTILLATE OIL COMBUSTION

Pollutant	lb/10^3 gal
Particulates	2.5
Sulfur Oxide	71.0
Nitrogen Oxide	18.0
Hydrocarbon	1.0
Carbon Monoxide	5.0

a. Assumes S = 0.5%

Source: AP-42

Step 5

The same assumptions as the New Jersey sector.

A 1c RESIDUAL OIL - RESIDENTIAL

Update Level: 2 [p. 61, Guidelines, Vol. 7]
Projection Level: 2 [p. 123, Guidelines, Vol. 7]
Allocation Order: 3 [p. 31, Guidelines, Vol. 13]

Substance and sequence of steps are given in the work chart. The following details are provided for those steps where procedures are not obvious.

NEW JERSEY

Step 1

Residual oil used in square kilometer j. A_j , and by county (9 counties of northeastern New Jersey) was estimated using the formula

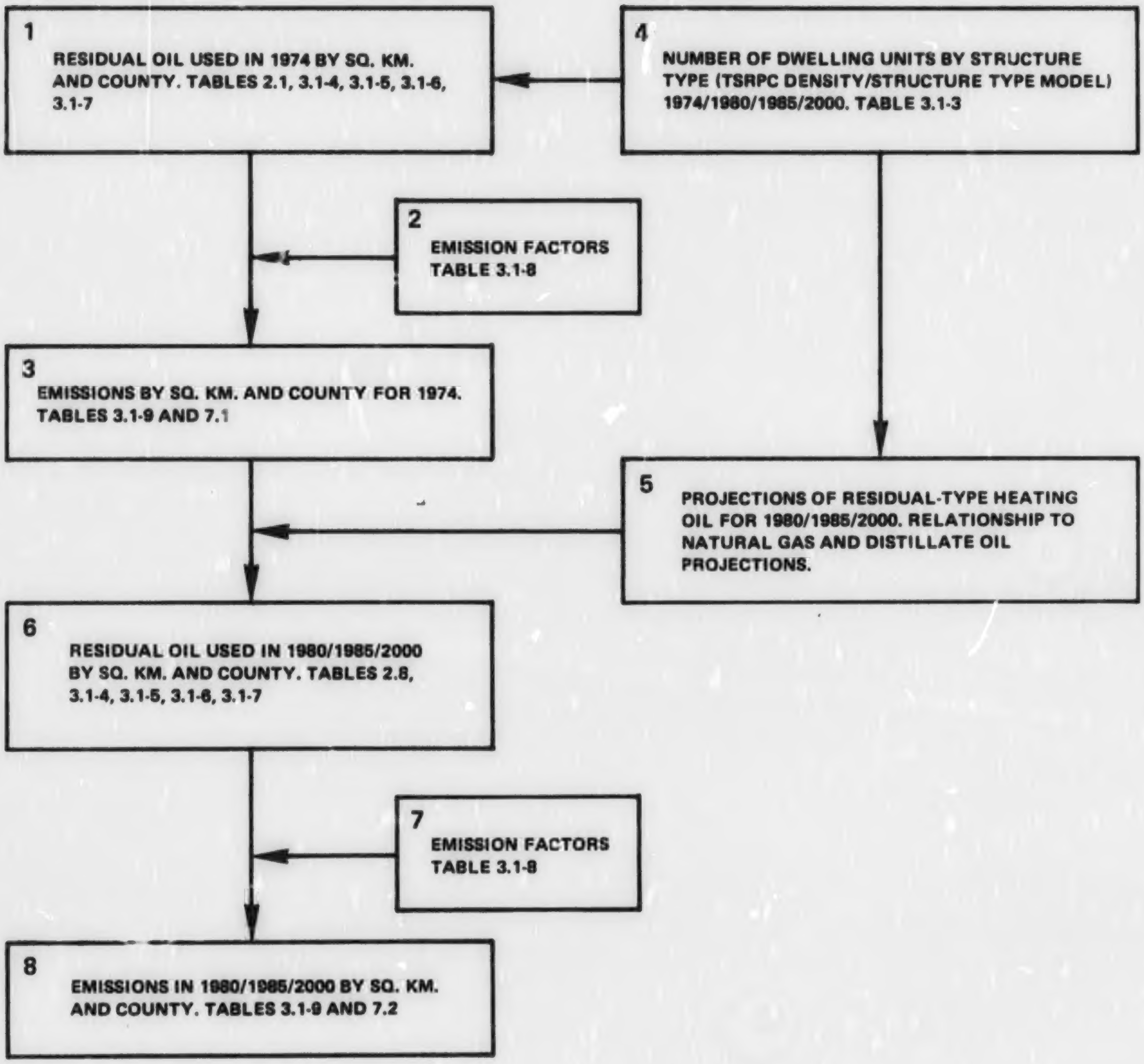
$$A_j = \sum_{i=3}^{4} B_{ij} \times F_i \times H_j \times C \times FUF_i$$

where B_{ij} = the number of dwelling units in type i structures (i = 3, 5 to 19 du's/bldg; i = 4, 20 + du's/bldg) in square kilometer j. (See Appendix IV for source)

LEVEL: 2
ORDER: 3

A 1c RESIDUAL OIL – RESIDENTIAL

(AREA SOURCE)


1
RESIDUAL OIL USED IN 1974 BY SQ. KM. AND COUNTY. TABLES 2.1, 3.1-4, 3.1-5, 3.1-6, 3.1-7
4
NUMBER OF DWELLING UNITS BY STRUCTURE TYPE (TSRPC DENSITY/STRUCTURE TYPE MODEL) 1974/1980/1985/2000. TABLE 3.1-3
2
EMISSION FACTORS TABLE 3.1-8
3
EMISSIONS BY SQ. KM. AND COUNTY FOR 1974. TABLES 3.1-9 AND 7.1
5
PROJECTIONS OF RESIDUAL-TYPE HEATING OIL FOR 1980/1985/2000. RELATIONSHIP TO NATURAL GAS AND DISTILLATE OIL PROJECTIONS.
6
RESIDUAL OIL USED IN 1980/1985/2000 BY SQ. KM. AND COUNTY. TABLES 2.8, 3.1-4, 3.1-5, 3.1-6, 3.1-7
7
EMISSION FACTORS TABLE 3.1-8
8
EMISSIONS IN 1980/1985/2000 BY SQ. KM. AND COUNTY. TABLES 3.1-9 AND 7.2

New Jersey Step 1 cont.

F_i = the fraction of dwelling units using oil for heating in type i structures (obtained from TSRPC "Housing and Neighborhood Survey")for the New Jersey sector.

H_j = heating degree days (hdd) in square kilometer j.

C = the county average number of rooms per dwelling unit divided by 5.

FUF_i= the fuel use factor (gal/du-hdd) for du's in type i structures.

The frequency distribution of residual oil use as a function of building size was approximated by assuming that structures with 4 or less dwelling units use no residual oil. For northeastern New Jersey

i	F_i	FUF_i
3	0.576	0.115
4	0.941	0.085

Step 2

EMISSION FACTORS FOR RESIDENTIAL RESIDUAL OIL COMBUSTION

Residential buildings of five or more units are the only ones assumed to use residual oil and these are apartments. EPA tabular data formats provide for reporting apartment use as if commercial. Thus, factors used are the same as for commercial uses.

New Jersey cont.

Pollutant	$lb/10^3$ gal
Particulates	10.
Sulfur Oxide	$157\ S^a = 47.1$
Nitrogen Oxides	60.0
Hydrocarbon	1.0
Carbon Monoxide	5.0

a. S = 0.3

Source: AP-42

Step 5

Methodology used in forecasting residential fuel usage permitted existing gas usage to continue but allowed no increase in gas usage.

It is assumed that all future demand in space heating will be supplied by oil. This assumption is based upon analyses performed by FEA and reported in "National Energy Outlook, February 1976." This scenario has maximum validity through 1985, with decreasing reliability thereafter.

Step 7

Same as Step 2.

NEW YORK CITY

Step 1

Data by county was supplied directly by New York City Department of Air Resources. Methods used to develop these data are described in technical reports prepared by the Bureau of Technical Services. Allocation to square kilometers was performed using the following method. The number of dwelling units using oil in square kilometer j in building size i, N_{ij}, was estimated from the product

$$N_{ij} = n_{ij} \times F_i$$

where n_{ij} = the number of dwelling units in building size i (i = 1, 1 du/bldg; i = 2, 2 to 4 du's/bldg; i = 3, 5 to 19 du's/bldg; i = 4, 20 + du's/bldg) in square kilometer j. (See Appendix IV)

F_i = the fraction of dwelling units using oil in building size i, obtained from the TSRPC "Housing and Neighborhood Survey," for the New York City sector.

The frequency distribution of residual oil use as a function of building size was approximated by assuming that residual oil is used only in buildings with 5 or more dwelling units. Then residual oil used in square kilometer j, A_j, is estimated from

$$A_j = C_T \times \frac{\sum_{i=1}^{2} N_{ij}}{\sum_{j=1}^{Z} \sum_{i=1}^{2} N_{ij}}$$

where C_T = county total of residual oil (supplied by NYCDAR)

Z = total number of square kilometers in the county

New York City cont.

Step 2

EMISSION FACTORS FOR RESIDENTIAL RESIDUAL OIL COMBUSTION

Pollutant	$lb/10^3$ gal
Particulates	8.7
Sulfur Oxides	$150\ S^a = 45.0$
Nitrogen Oxides	48.6
Hydrocarbons	0.22
Carbon Monoxide	0.8

a. S = 0.3

Source: NYC DAR

Step 5

Same as New Jersey, Step 5.

Step 7

Same as Step 2.

NEW YORK STATE

Steps 1 through 4

Total fuel use by fuel type by user class was calculated by New York Department of Environmental Conservation. Residential residual oil usage for each county was estimated by subtracting the point source usage from the total for that county. See Appendix VI, Statewide Fuel Balance Calculations for 1974, New York State.

New York State cont.

Step 2

EMISSION FACTORS FOR RESIDENTIAL RESIDUAL OIL COMBUSTION

Pollutant	Rockland, Westchester, Nassau lb/10^3 gal	(Western) Suffolk[b] lb/10^3 gal	Eastern Suffolk[d] Orange, Putnam, Dutchess lb/10^3 gal
Particulates	6.7	13.0	23.0
Sulfur Oxides	157 S[a] = 58.1	157 S[c] = 157.	157 S[e] = 314.
Nitrogen Oxides	60.0	60.0	60.0
Hydrocarbons	1.0	1.0	1.0
Carbon Monoxide	5.0	5.0	5.0

Source: AP-42, New York State Point Source Inventory

a. S = 0.37

b. Towns of Babylon, Brookhaven, Huntington, Islip, and Smithtown.

c. S = 1.00

d. Towns of Easthampton, Riverhead, Shelter Island, Southampton, Southold.

e. S = 2.00

Step 5

The same as New Jersey, Step 5.

Step 7

Same as Step 2.

CONNECTICUT (Fairfield County)

Step 1

There was no residential residual oil use in Fairfield County in 1974, according to data supplied by the CONNDEP. No emissions are assumed for the future.

A 2a NATURAL GAS - COMMERCIAL

Update Level: 2 [pp 61-64, Guidelines, Vol. 7]
Projection Level: 2 [p. 123, Guidelines, vol. 7]
Allocation Order: 2 [pp 80-81, Guidelines, Vol. 13]

Substance and sequence of steps are given in the work chart. The following details are provided for those steps where procedures are not obvious.

NEW JERSEY

Step 1

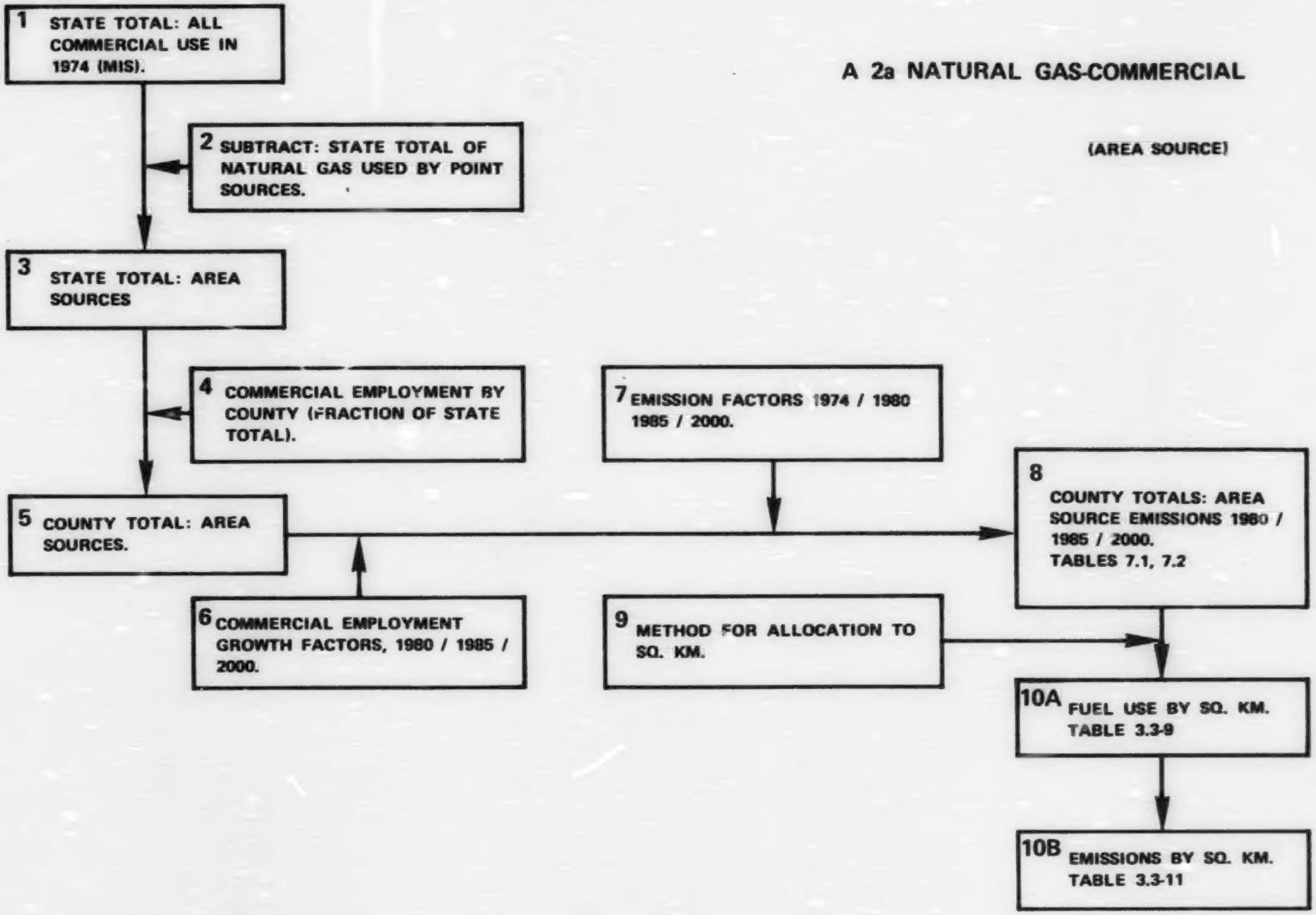
MIS = $58,210.\text{x}10^6$ cu.ft.

Step 2

State total commercial point source use = $1,485. \times 10^6$ cu.ft.

A 2a NATURAL GAS-COMMERCIAL

(AREA SOURCE)


1 STATE TOTAL: ALL COMMERCIAL USE IN 1974 (MIS).
2 SUBTRACT: STATE TOTAL OF NATURAL GAS USED BY POINT SOURCES.
3 STATE TOTAL: AREA SOURCES
4 COMMERCIAL EMPLOYMENT BY COUNTY (FRACTION OF STATE TOTAL).
5 COUNTY TOTAL: AREA SOURCES.
6 COMMERCIAL EMPLOYMENT GROWTH FACTORS, 1980 / 1985 / 2000.
7 EMISSION FACTORS 1974 / 1980 1985 / 2000.
8 COUNTY TOTALS: AREA SOURCE EMISSIONS 1980 / 1985 / 2000. TABLES 7.1, 7.2
9 METHOD FOR ALLOCATION TO SQ. KM.
10A FUEL USE BY SQ. KM. TABLE 3.3-9
10B EMISSIONS BY SQ. KM. TABLE 3.3-11

New Jersey cont.

Step 3

State total: Area sources = cu.ft.

Step 4

County	Comm/Inst.Employment (in thousands)	Ratio: County Comm Employ./State Comm.Employ.
Bergen	312.2	0.127
Essex	349.2	0.142
Hudson	193.8	0.078
Middlesex	198.3	0.080
Monmouth	139.5	0.056
Morris	113.4	0.046
Passaic	152.1	0.061
Somerset	64.2	0.026
Union	230.0	0.093
State total	2,454.5	

Source: TSRPC ITR 4545-1202 "Regional and County Employment Monitoring, Year 1974." February 1976.

Step 5

County	Area source (10^6 cu.ft.)
Bergen	7,204.
Essex	8,055.
Hudson	4,425.
Middlesex	4,538.
Monmouth	3,177.

New Jersey

Step 5 cont.

County	Area source (10^6 cu.ft.)
Morris	2,609.
Passaic	3,460.
Somerset	1,475.
Union	5,275.

Step 6

Commercial/Institutional Employment Growth Factors

County	1974	1980	1985	2000
Bergen	1.000	1.038	1.104	1.301
Essex	1.000	1.002	1.005	1.095
Hudson	1.000	0.993	1.040	1.247
Middlesex	1.000	1.096	1.205	1.505
Monmouth	1.000	1.088	1.161	1.403
Morris	1.000	1.057	1.118	1.324
Passaic	1.000	0.996	1.014	1.143
Somerset	1.000	1.020	1.097	1.327
Union	1.000	0.997	0.995	1.024

See Appendix V for derivation.

New Jersey cont.

Step 7

EMISSION FACTORS FOR COMMERCIAL NATURAL GAS COMBUSTION

Pollutant	lb/10^6 ft^3
Particulates	10.
Sulfur oxides (SO_2)	0.6
Nitrogen Oxides (NO_2)	120.
Hydrocarbons (CH_4)	8.
Carbon monoxide	20.

Source: AP-42

Step 9

Allocation of commercial-institutional fuel use by total floor area (including residential) is admittedly a generalized approach. A more sensitized method was used to allocate to land use units described as "Economic Cluster" (Type 1) and "Cluster Related Residential" (Type 2). The former are defined as appearing on "cross-accepted" county plan maps as areas of predominately "economic or institutional activity" and generally having, or will have, nonresidential floor space equal to or greater than 38% of total floor space, and nonresidential floor space equal to or greater than 500,000 square feet. Exceptions to these floor space rules would include predominantly "open" or low density uses like airport runways and oil tank farms. "Cluster Related Residential" square miles are defined as generally adjacent to "Economic Clusters" and are usually defined on county plans as areas of extensive higher residential density or predominantly residential. Thus, it is likely that commercial/institutional emissions would come mainly from these types of areas. A computer procedure was evolved which made such special allocation possible.

See ITR 4351-5401: "The Land Development System..., an Overview" for the context of this part of the land use modelling system.

NEW YORK CITY

Step 1

MIS = 136,332.x10^6. This datum was not used in subsequent calculations, and is recorded for possible use in checking whether results are reasonable.

Steps 2 and 3

Omit

New York City cont.

Step 4

County	Comm./Inst.Employment (000's)
Bronx	242.7
Kings	518.7
New York	2,014.8
Queens	438.3
Richmond	55.4
State total	6,575.1

These data were not used in subsequent calculations, and are recorded for possible use in checking if results are unreasonable.

Step 5

Data supplied by New York City Department of Air Resources.

County	Area Source Total (10^3 cu.ft.)
Bronx	4,694,052
Kings	8,781,462
New York	7,708,224
Queens	8,187,217
Richmond	548,050

New York City cont.

Step 6

Commercial Employment Growth Factors

County	1974	1980	1985	2000
Bronx	1.000	0.982	1.019	1.166
Kings	1.000	0.984	0.979	1.036
New York	1.000	1.046	1.092	1.109
Queens	1.000	0.998	1.003	1.056
Richmond	1.000	1.213	1.390	1.836

See Appendix V for derivation.

Step 7

EMISSION FACTORS FOR COMMERCIAL NATURAL GAS COMBUSTION

Pollutant	lb/10^6 cu.ft.
Particulates	6.
Sulfur Oxides (SO)	0.6
Nitrogen Oxides (NO)	100.
Hydrocarbons (CH)	4.
Carbon Monoxide	20.

Source: NYCDAR

Step 9

Same method as New Jersey

NEW YORK STATE (excluding New York City)

Steps 1 through 5

Total fuel use by fuel type by user class was calculated by New York Department of Environmental Conservation. Commercial/institutional natural gas usage for each county was estimated by subtracting the point source usage from the total for that county. See Appendix VI, Statewide Fuel Balance Calculations for 1974, New York State.

Step 6

Commercial/Institutional Employment Growth Factors

County	1974	1980	1985	2000
Dutchess	1.000	1.068	1.126	1.330
Nassau	1.000	0.989	0.999	1.092
Orange	1.000	1.148	1.271	1.618
Putnam	1.000	1.007	1.050	1.302
Rockland	1.000	1.057	1.105	1.272
Suffolk	1.000	1.079	1.147	1.286
Westchester	1.000	0.999	1.037	1.162

See Appendix V for derivation.

New York State cont.

Step 7

EMISSION FACTORS FOR NATURAL GAS COMBUSTION

Pollutant	lb/10 cu.ft.
Particulates	10.
Sulfur Oxides	0.6
Nitrogen Oxides	120.
Hydrocarbons	8.
Carbon Monoxide	20.

Source: AP-42

Step 9

Same method as New Jersey

CONNECTICUT (Fairfield County)

Steps 1 through 9

Commercial/institutional natural gas data were supplied by the Connecticut Department of Environmental Protection by MCD. Methods used to develop these data are described in Appendix A, Connecticut Air Inventory Reference (CONNAIR), Department of Environmental Protection, Air Compliance Unit, Engineering Section. Allocation to square kilometers was accomplished by the same methods used for New York City, but with MCD totals replacing county totals.

Connecticut (Fairfield County) cont.

Step 4

County	Commercial Employment (in thousands)			
	1974	1980	1985	2000
Fairfield	335.5	338.7	343.2	383.4

Step 5

Data supplied by CONNDEP by MCD

Step 6

Commercial Employment Growth Factors

County	1974	1980	1985	2000
Fairfield	1.000	1.010	1.023	1.143

See Appendix V for derivation.

Connecticut (Fairfield County) cont.

Step 7

EMISSION FACTORS FOR COMMERCIAL NATURAL GAS COMBUSTION

Pollutant	$lb/10^6$ cu.ft.
Particulates	10.0
Sulfur Oxide	0.6
Nitrogen Oxide	120.0
Hydrocarbon	8.0
Carbon Monoxide	20.0

Source: AP-42

Step 9

Same method as New Jersey

A 2b DISTILLATE - COMMERCIAL/INSTITUTIONAL AND INDUSTRIAL

Update Level: 2 [pp. 62-63, Guidelines, Vol. 7]

Projection Level: 2 [p. 123, Guidelines, Vol. 7]

Allocation Order: 2 [pp. 80-81, Guidelines, Vol. 13]

Substance and sequence of steps are given in the work chart. The following details are provided for those steps where procedures are not obvious.

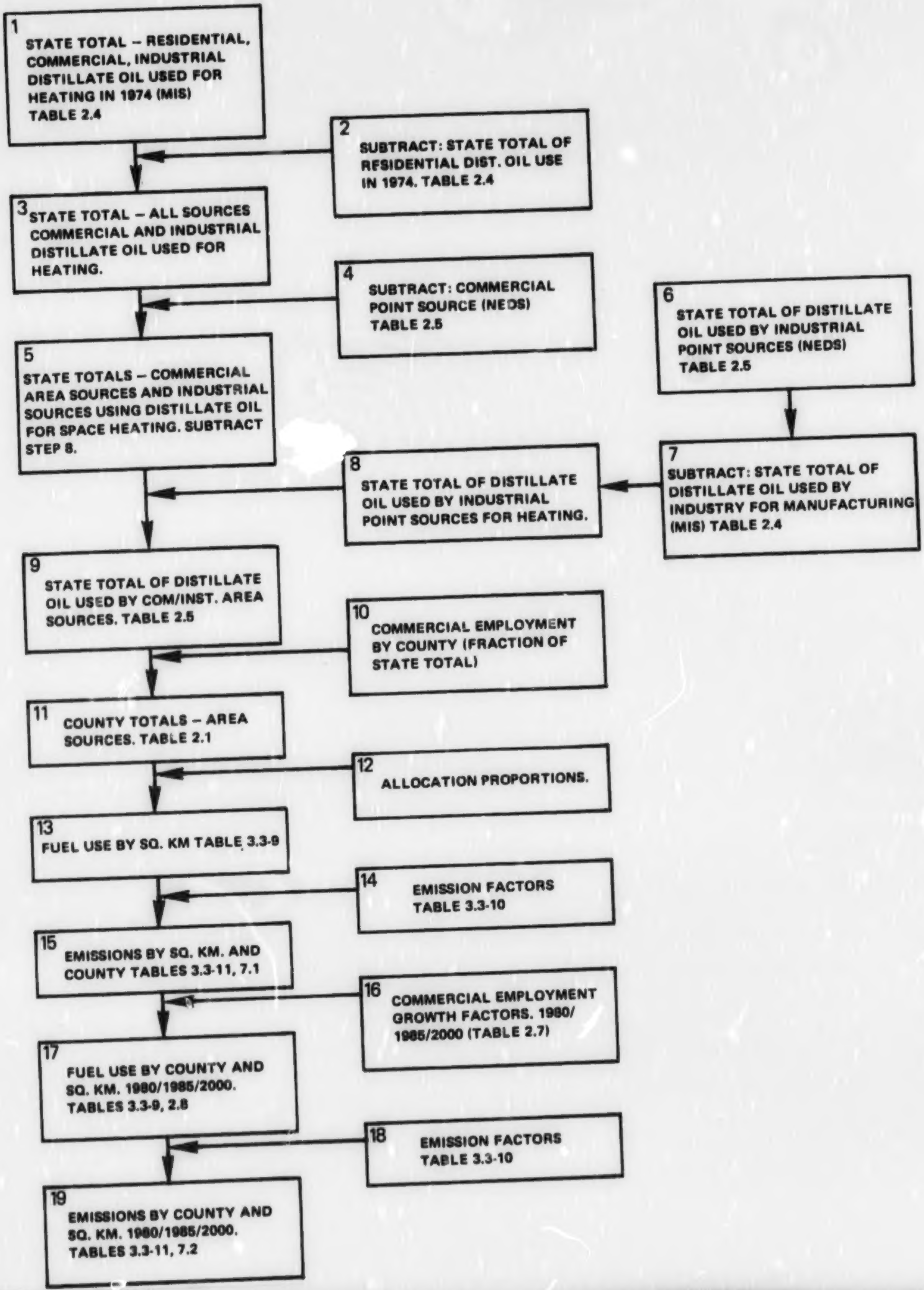
NEW JERSEY

Step 1

"Distillate-type heating oil, "(MIS) =	1,894,578,000. gal
"Kerosine used for heating, "(MIS) =	44,562,000. gal
"Distillate used by the military," (MIS) =	13,440,000. gal
Total	1,952,580,000. gal

This is the state total of residential, commercial, and industrial distillate oil used for space heating, and conforms with the definitions on Bureau of Mines form "FUEL OIL AND KEROSINE SALES AND INVENTORIES."

A 2b/ A 3b DISTILLATE – COMMERCIAL & INDUSTRIAL


1 STATE TOTAL – RESIDENTIAL, COMMERCIAL, INDUSTRIAL DISTILLATE OIL USED FOR HEATING IN 1974 (MIS) TABLE 2.4
2 SUBTRACT: STATE TOTAL OF RESIDENTIAL DIST. OIL USE IN 1974. TABLE 2.4
3 STATE TOTAL – ALL SOURCES COMMERCIAL AND INDUSTRIAL DISTILLATE OIL USED FOR HEATING.
4 SUBTRACT: COMMERCIAL POINT SOURCE (NEDS) TABLE 2.5
5 STATE TOTALS – COMMERCIAL AREA SOURCES AND INDUSTRIAL SOURCES USING DISTILLATE OIL FOR SPACE HEATING. SUBTRACT STEP 8.
6 STATE TOTAL OF DISTILLATE OIL USED BY INDUSTRIAL POINT SOURCES (NEDS) TABLE 2.5
7 SUBTRACT: STATE TOTAL OF DISTILLATE OIL USED BY INDUSTRY FOR MANUFACTURING (MIS) TABLE 2.4
8 STATE TOTAL OF DISTILLATE OIL USED BY INDUSTRIAL POINT SOURCES FOR HEATING.
9 STATE TOTAL OF DISTILLATE OIL USED BY COM/INST. AREA SOURCES. TABLE 2.5
10 COMMERCIAL EMPLOYMENT BY COUNTY (FRACTION OF STATE TOTAL)
11 COUNTY TOTALS – AREA SOURCES. TABLE 2.1
12 ALLOCATION PROPORTIONS.
13 FUEL USE BY SQ. KM TABLE 3.3-9
14 EMISSION FACTORS TABLE 3.3-10
15 EMISSIONS BY SQ. KM. AND COUNTY TABLES 3.3-11, 7.1
16 COMMERCIAL EMPLOYMENT GROWTH FACTORS. 1980/1985/2000 (TABLE 2.7)
17 FUEL USE BY COUNTY AND SQ. KM. 1980/1985/2000. TABLES 3.3-9, 2.8
18 EMISSION FACTORS TABLE 3.3-10
19 EMISSIONS BY COUNTY AND SQ. KM. 1980/1985/2000. TABLES 3.3-11, 7.2

New Jersey cont.

Step 2

The state total of residential distillate oil use in in 1974, A, was estimated using the equation

$$A = \sum_{i=1}^{2} B_i \times F_i \times H \times C \times FUF_i$$

where B_i = the number of dwelling units in structure type i (i = 1, 1 du/bldg; i = 2, 2 to 4 du's/bldg) (Source: see Appendix IV)

F_i = the fraction of dwelling units using oil in structure type i, obtained from the TSRPC "Housing and Neighborhood Survey," for the New Jersey sector.

H = the number of heating degree days

C = the average number of rooms per dwelling unit/5.0

FUF_i = the fuel use factor (gal/du-hdd) for structure type i

The frequency distribution of distillate oil use by building size was approximated by assuming that distillate oil is used only in building types with i equal 1 and 2. Then, using the values below, the State total of residential distillate oil use = 611,011,000. gal.

i	B_i	F_i	H	C	FUF_i
1	1,380,095.	0.344	5000.	1.05	0.157
2	503,749.	0.585	5000.	1.05	0.142

New Jersey cont.

Step 3

State total of distillate oil used by commercial/institutional and industrial sources for heating = 1,341,569,000. gal.

Step 4

State total of distillate used by commercial/institutional point sources (from NEDS file) = 159,000. gal.

Step 5

State total of distillate oil used for heating by commercial/institutional area sources and industrial sources = 1,341,410,000. gal.

Step 6

State total of distillate oil used by industrial point sources (NEDS) = 114,312,000. gal.

Step 7

"Industrial Use," (MIS) = 101,472,000. gal

"Oil Companies," (MIS) = 10,500,000. gal

State total of distillate oil used by industry for manufacturing (MIS) = 111,972,000. gal.

New Jersey cont.

Step 8

State total of distillate oil used by industrial [point] sources for heating = 2,340,000. gal.

Step 9

State total of distillate oil used by commercial/institutional area sources = 1,339,070,000. gal.

Step 10

County	1974 Comm Employment (000's)	County Comm.Employ/ State Comm.Employ
Bergen	312.2	0.127
Essex	349.2	0.142
Hudson	193.8	0.079
Middlesex	198.3	0.081
Monmouth	139.5	0.057
Morris	113.4	0.046
Passaic	152.1	0.062
Somerset	64.2	0.026
Union	230.0	0.094

State total 2,454,500

New Jersey cont.

Step 11

County	County totals-area sources (gal)
Bergen	170,062,000.
Essex	190,148,000.
Hudson	105,787,000.
Middlesex	108,465,000.
Monmouth	76,327,000.
Morris	61,597,000.
Passaic	83,022,000.
Somerset	34,816,000.
Union	125,873,000.

Step 12

See alternative to allocation by floor area in A 2a , Step 9, p 5.

New Jersey cont.

Step 14

EMISSION FACTORS FOR COMMERCIAL DISTILLATE OIL COMBUSTION

Pollutant	$lb/10^3$ gal.
Particulates	2.
Sulfur Oxides	142 s[a] = 28.4
Nitrogen Oxides	22.
Hydrocarbons	1.
Carbon Monoxide	5.

Source: AP-42

a. S = 0.2

Step 16

	Commercial/Institutional Employment (in thousands)			
County	1974	1980	1985	2000
Bergen	312.2	323.9	344.5	406.3
Essex	349.2	349.9	351.0	382.2
Hudson	193.8	192.4	201.6	241.6
Middlesex	198.3	217.3	238.9	298.5
Monmouth	139.5	151.7	161.9	195.7
Morris	113.4	119.9	126.8	150.0
Passaic	152.1	151.5	154.2	173.9
Somerset	64.2	65.5	70.4	85.2
Union	230.0	229.4	228.8	235.6

See Appendix V for derivation.

New Jersey Step 16 cont.

Growth Factors

County	1974	1980	1985	2000
Bergen	1.00	1.038	1.104	1.301
Essex	1.00	1.002	1.005	1.095
Hudson	1.00	0.993	1.040	1.247
Middlesex	1.00	1.096	1.205	1.505
Monmouth	1.00	1.088	1.161	1.403
Morris	1.00	1.057	1.118	1.324
Passaic	1.00	0.996	1.014	1.143
Somerset	1.00	1.020	1.097	1.327
Union	1.00	0.997	0.995	1.024

Step 18

Same factors as Step 14.

NEW YORK CITY

Steps 1 to 10

Omitted

Step 11

Data supplied by New York City Department of Air Resources. Methods used to develop these data are described in technical reports prepared by the Bureau of Technical Services.

New York City cont.

Step 12

The same procedure as used in the New Jersey sector.

Step 14

EMISSION FACTORS FOR COMMERCIAL DISTILLATE OIL COMBUSTION

	#2 Oil	#4 Oil
Pollutant	lb/10 gal	lb/10 gal
Particulates	1.2	4.3
Sulfur Oxides	142 S[a] = 28.4	148 S[b] = 44.4
Nitrogen Oxides	24.9	45.9
Hydrocarbons	0.17	0.2
Carbon Monoxide	0.5	0.7

Source: NYCDAR

a. S = 0.2

b. S = 0.3

The emission factors used for distillate-type oil were weighted averages, where the weights are the fractions of #2 and #4 oil used.

New York City Step 14 cont.

EMISSION FACTORS FOR COMMERCIAL DISTILLATE OIL COMBUSTION -- WEIGHTED AVERAGE

Pollutant	$lb/10^3$ gal
Particulates	2.148
Sulfur Oxides	33.294
Nitrogen Oxides	31.324
Hydrocarbons	0.179
Carbon Monoxide	0.561

a. S = .226 average

Step 16

Commercial Employment (ooo's)

County	1974	1980	1985	2000
Bronx	242.7	238.4	247.4	283.0
Kings	518.7	510.3	508.0	537.2
New York	2,014.8	2,107.0	2,199.6	2,235.4
Queens	438.3	437.3	439.8	462.7
Richmond	55.4	67.2	77.0	101.7

Commercial Employment Growth Factors

County	1974	1980	1985	2000
Bronx	1.00	0.982	1.019	1.166
Kings	1.00	0.984	0.979	1.036
New York	1.00	1.046	1.092	1.109
Queens	1.00	0.998	1.003	1.056
Richmond	1.00	1.213	1.390	1.836

See Appendix V for derivation.

New York City cont.

Step 18

Same emission factors as Step 14.

NEW YORK STATE

Steps 1 through 11

Total fuel use by fuel type by user class was calculated by New York Department of Environmental Conservation. Commercial/institutional distillate oil usage for each county was estimated by subtracting the point source usage from the total for that county. See Appendix VI, Statewide Fuel Balance Calculations for 1974, New York State.

Step 12

Same allocation method as used in the New Jersey sector.

New York State cont.

Step 14

EMISSION FACTORS FOR COMMERCIAL DISTILLATE OIL COMBUSTION

Pollutant	Rockland, Westchester, Nassau lb/10^3 gal	(Western)[b] Suffolk lb/10^3 gal	Eastern Suffolk[d] and Orange, Putnam, Dutchess lb/10^3 gal
Particulates	2.0	2.0	2.0
Sulfur Oxides	142 S[a] = 52.5	142 S[c] = 142.0	142 S[e] = 284.0
Nitrogen Oxides	22.0	22.0	22.0
Hydrocarbons	1.0	1.0	1.0
Carbon Monoxide	5.0	5.0	5.0

a. S = 0.37

b. Towns of Babylon, Brookhaven, Huntington, Islip, and Smithtown.

c. S = 1.00

d. Towns of Easthampton, Riverhead, Shelter Island, Southampton, Southold.

e. S = 2.00

Source: AP-42

Step 16

County	Commercial Employment (in thousands) 1974	1980	1985	2000
Dutchess	76.0	81.2	85.6	101.0
Nassau	477.3	472.1	477.2	521.0
Orange	70.5	80.9	89.6	114.1
Putnam	13.9	14.0	14.6	18.1
Rockland	71.4	75.5	78.9	90.8
Suffolk	355.7	384.1	407.8	457.5
Westchester	312.3	312.2	323.8	362.8

New York State Step 16 cont.

Growth Factors

County	1974	1980	1985	2000
Dutchess	1.00	1.068	1.126	1.330
Nassau	1.00	0.989	0.999	1.092
Orange	1.00	1.148	1.271	1.618
Putnam	1.00	1.007	1.050	1.302
Rockland	1.00	1.057	1.105	1.272
Suffolk	1.00	1.079	1.147	1.286
Westchester	1.00	0.999	1.037	1.162

See Appendix V for derivation.

Step 18

Same emission factors as Step 14.

CONNECTICUT

Steps 1 to 10

Omitted

Step 11

Data supplied by Connecticut Department of Environmental Protection by MCD. Methods used to develop these data are described in "Appendix A, Connecticut Air Inventory Reference (CONNAIR), Dept. of Environmental Protection, Air Compliance Unit, Engineering Section.

Connecticut cont.

Step 12

Fuel use was allocated to square kilometers by the same methods used for New York City sector, but with MCD totals replacing county totals.

Step 14

EMISSION FACTORS FOR COMMERCIAL DISTILLATE OIL COMBUSTION

Pollutant	$lb/10^3$ gal
Particulates	2.0
Sulfur Oxides	71.0[a]
Nitrogen Oxides	22.0
Hydrocarbons	1.0
Carbon Monoxide	5.0

a. Assumes .5% sulfur content

Source: Conn DEP

Step 16

County	Comm./Inst. Employment (in thousands) 1974	1980	1985	2000
Fairfield	335.5	338.7	343.2	383.4

County	Growth actors 1974	1980	1985	2000
Fairfield	1.00	1.010	1.023	1.143

Connecticut cont.

Step 18

Same emission factors as Step 14.

A 2c RESIDUAL OIL - COMMERCIAL/INSTITUTIONAL AND INDUSTRIAL

Update Level: 2 [p. 61, Guidelines, Vol. 7]
Projection Level: 2 [p. 123, Guidelines, Vol. 7]
Allocation Order: 2 [p. 80, Guidelines, Vol. 13]

Substance and sequence of steps are given in the work chart. The following details are provided for those steps where procedures are not obvious.

NEW JERSEY

Step 1

"Residual-type heating oil," (MIS) = 476,826,000. gal
"Residual oil used by the military," (MIS) = 90,342,000. gal

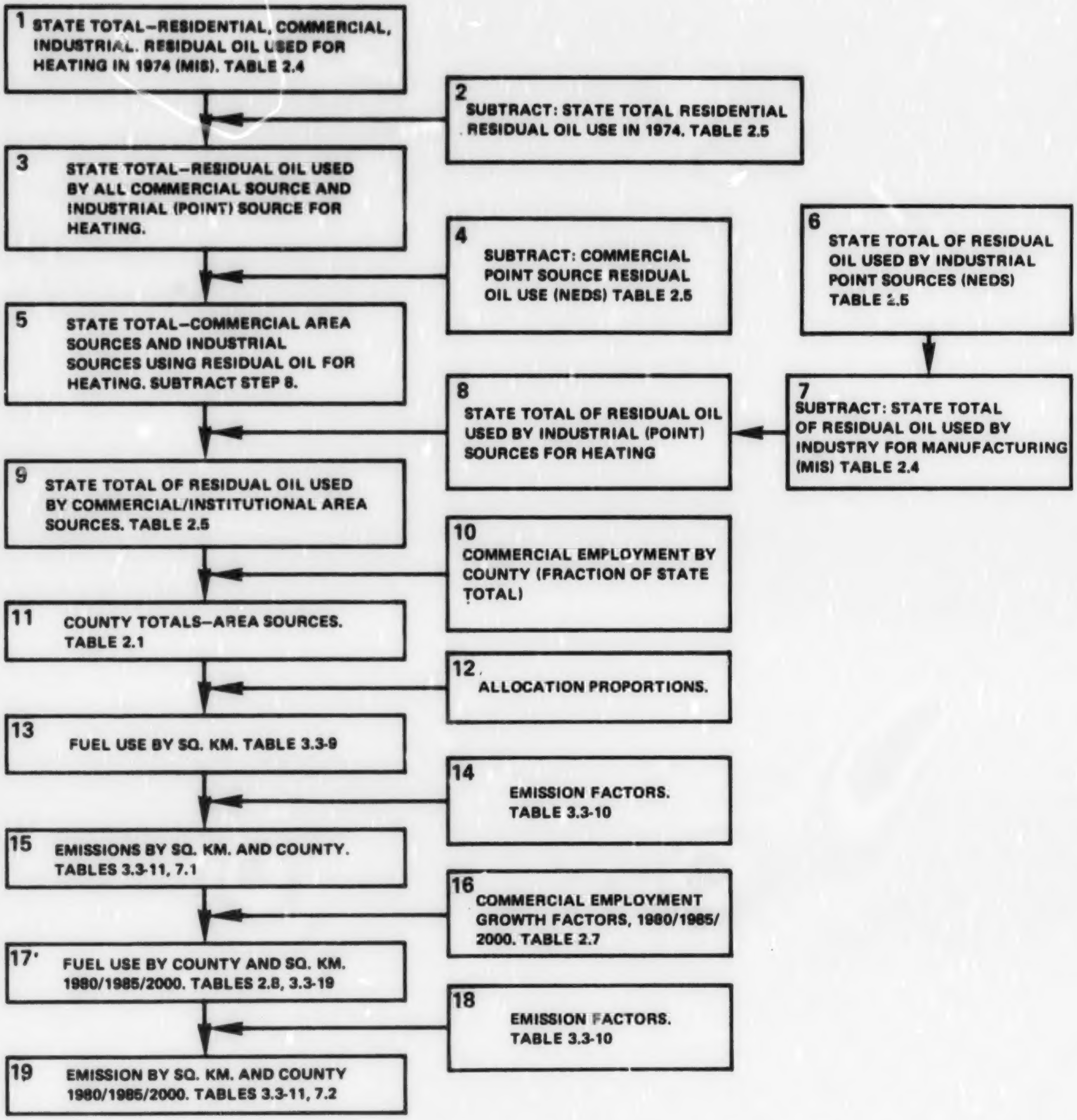
State total of residential, commercial, and industrial residual oil used for heating = 567,168,000. gal

A 2c/ 2

LEVEL: 2
ORDER: 2

A 2c RESIDUAL OIL – COMMERCIAL (+ INDUSTRIAL)

(AREA SOURCE)


1 STATE TOTAL–RESIDENTIAL, COMMERCIAL, INDUSTRIAL. RESIDUAL OIL USED FOR HEATING IN 1974 (MIS). TABLE 2.4
2 SUBTRACT: STATE TOTAL RESIDENTIAL RESIDUAL OIL USE IN 1974. TABLE 2.5
3 STATE TOTAL–RESIDUAL OIL USED BY ALL COMMERCIAL SOURCE AND INDUSTRIAL (POINT) SOURCE FOR HEATING.
4 SUBTRACT: COMMERCIAL POINT SOURCE RESIDUAL OIL USE (NEDS) TABLE 2.5
6 STATE TOTAL OF RESIDUAL OIL USED BY INDUSTRIAL POINT SOURCES (NEDS) TABLE 2.5
5 STATE TOTAL–COMMERCIAL AREA SOURCES AND INDUSTRIAL SOURCES USING RESIDUAL OIL FOR HEATING. SUBTRACT STEP 8.
8 STATE TOTAL OF RESIDUAL OIL USED BY INDUSTRIAL (POINT) SOURCES FOR HEATING
7 SUBTRACT: STATE TOTAL OF RESIDUAL OIL USED BY INDUSTRY FOR MANUFACTURING (MIS) TABLE 2.4
9 STATE TOTAL OF RESIDUAL OIL USED BY COMMERCIAL/INSTITUTIONAL AREA SOURCES. TABLE 2.5
10 COMMERCIAL EMPLOYMENT BY COUNTY (FRACTION OF STATE TOTAL)
11 COUNTY TOTALS–AREA SOURCES. TABLE 2.1
12 ALLOCATION PROPORTIONS.
13 FUEL USE BY SQ. KM. TABLE 3.3-9
14 EMISSION FACTORS. TABLE 3.3-10
15 EMISSIONS BY SQ. KM. AND COUNTY. TABLES 3.3-11, 7.1
16 COMMERCIAL EMPLOYMENT GROWTH FACTORS, 1980/1985/2000. TABLE 2.7
17 FUEL USE BY COUNTY AND SQ. KM. 1980/1985/2000. TABLES 2.8, 3.3-19
18 EMISSION FACTORS. TABLE 3.3-10
19 EMISSION BY SQ. KM. AND COUNTY 1980/1985/2000. TABLES 3.3-11, 7.2

New Jersey cont.

Step 2

The state total of residual oil used for residential heating in 1974, A, was estimated using the equation

$$A = \sum_{i=3}^{4} B_i \times F_i \times H \times C \times FUF_i$$

where B_i = the state total of dwelling units in structure type i (i = 3, 5 to 19 du's/bldg; i = 4, 20 + du's/bldg). (Source: see Appendix IV)

F_i = the fraction of dwelling units which use oil for heating in structure type i, in the New Jersey sector of the Region obtained from the TSRPC "Housing and Neighborhood Survey."

H = the state average number of heating degree days.

C = state average, number of rooms per dwelling unit/5.0

FUF = fuel use factor (gal/du-hdd) for dwelling units in structure type i.

The distribution of residual oil use by building size was approximated by assuming that buildings with 5 or more dwelling units which use oil use only residual oil. Using the values in the matrix below yields A = 190,423,000. gal.

i	B_i	F_i	H	C	FUF_i
3	269,877	0.576	5000	1.05	0.115
4	229,977	0.941	5000	1.05	0.085

Step 3

State total of residual oil used by all commercial sources and industrial [point] sources for heating = 376,745,000. gal.

New Jersey cont.

Step 4

State total of residual oil used by commercial point sources in 1974 from NEDS = 4,505,000. gal.

Step 5

State total of residual oil used by commercial area sources and industrial [point] sources for heating = 372,240,000. gal.

Step 6

State total of residual oil used by industrial point sources in NEDS = 908,733,000. gal.

Step 7

"Industrial Use, Residual Oil," (MIS) = 367,332,000. gal

"Oil Companies, Residual Oil," (MIS) = 233,688,000. gal

State total of residual oil used by industry for manufacturing, etc. = 601,020,000. gal

New Jersey cont.

Step 8

State total of residual oil used by industrial [point] sources for heating = 307,713,000. gal. It was assumed that there was no residual oil used at industrial facilities which did not have NJDEP permits.

Step 9

State total of residual oil used by commercial area sources = 64,527,000. gal. This means that the state total of residual oil used by commercial area sources was zero.

Step 10

County	Commercial Employment (in thousands)	County Comm. Employ. / State Comm. Employ.
Bergen	312.2	0.127
Essex	349.2	0.142
Hudson	193.8	0.079
Middlesex	198.3	0.081
Monmouth	139.5	0.057
Morris	113.4	0.046
Passaic	152.1	0.062
Somerset	64.2	0.026
Union	230.0	0.094
State total	2,454.5	

Source: TSRPC ITR 4545-1202 "Regional and County Employment Monitoring, Year 1974." February 1976.

New Jersey cont.

Step 11

County	Commercial Residual Oil Area Source Totals (gals)
Bergen	8,195,000.
Essex	9,163,000.
Hudson	5,098,000.
Middlesex	5,227,000.
Monmouth	3,678,000.
Morris	2,968,000.
Passaic	4,001,000
Somerset	1,678,000.
Union	6,066,000

NEW YORK CITY

Steps 1 to 10

Omitted

Step 11

County totals were supplied by the New York City Department of Air Resources. Methods used to estimate these totals are described in technical reports prepared by the Bureau of Technical Services.

	AREA SOURCE TOTALS	
County	Commercial/Institutional (10^7 gallons)	Industrial (10^4 gallons)
Bronx	5169	675
Kings	9156	3045
New York	7819	6047
Queens	8895	2027
Richmond	1696	511

Step 12

The procedure was the same as that described in A-2b: Commercial Distillate Oil Use.

New York City cont.

Step 14

EMISSION FACTORS FOR COMMERCIAL RESIDUAL OIL COMBUSTION

Pollutant	$lb/10^3$ gal
Particulate	8.7
Sulfur Oxides	$150\ S^a = 45.$
Nitrogen Oxides	48.6
Hydrocarbons	0.22
Carbon Monoxide	0.8

a. S = 0.3

Source: NYCDAR

Step 16

COMMERCIAL EMPLOYMENT (in thousands)

County	1974	1980	1985	2000
Bronx	242.7	238.4	247.4	283.0
Kings	518.7	510.3	508.0	537.2
New York	2,014.8	2,107.0	2,199.6	2,235.4
Queens	438.3	437.3	439.8	462.7
Richmond	55.4	67.2	77.0	101.7

New York City Step 16 cont.

County	COMMERCIAL EMPLOYMENT GROWTH FACTORS 1974	1980	1985	2000
Bronx	1.00	0.982	1.019	1.166
Kings	1.00	0.984	0.979	1.036
New York	1.00	1.046	1.092	1.109
Queens	1.00	0.998	1.003	1.056
Richmond	1.00	1.213	1.390	1.836

See Appendix V for derivation.

Step 18

The same emission factors as Step 14.

NEW YORK STATE

Steps 1 through 11

Total fuel use by fuel type by user class was calculated by New York Department of Environmental Conservation. Commercial/institutional residual oil usage for each county was estimated by subtracting the point source usage from the total for that county. See Appendix VI, Statewide Fuel Balance Calculations for 1974, New York State.

New York State Step 11 cont.

Step 12

The procedure used to allocate residual oil to commercial sources is the same as that followed in A-2b: Commercial Distillate Oil Use.

Step 14

EMISSION FACTORS FOR COMMERCIAL RESIDUAL OIL USE

	Rockland, Westchester, Nassau	(Western) Suffolk^3	Eastern Suffolk^d and Orange, Putnam, Dutchess
Pollutant	lb/10^3 gal	lb/10^3 gal	lb/10^3 gal
Particulates	6.7	13.0	23.0
Sulfur Oxide	157 S^a = 58.1	157 S^c = 157.0	157 S^e = 314.0
Nitrogen Oxides	60.1	60.0	60.0
Hydrocarbons	1.0	1.0	1.0
Carbon Monoxide	5.0	5.0	5.0

Source: AP-42, New York State Point Source Inventory

a. S = 0.37

b. Towns of Babylon, Brookhaven, Huntington, Islip, and Smithtown

c. S = 1.00

d. Towns of Easthampton, Riverhead, Shelter Island, Southampton, Southold.

S = 2.0

New York State cont.

Step 16

COMMERCIAL EMPLOYMENT (in thousands)

County	1974	1980	1985	2000
Dutchess	76.0	81.2	85.6	101.1
Nassau	477.3	472.1	477.2	521.0
Orange	70.5	80.9	89.6	114.1
Putnam	13.9	14.0	14.6	18.1
Rockland	71.4	75.5	78.9	90.8
Suffolk	355.7	384.1	407.8	457.5
Westchester	312.3	312.2	323.8	362.8

COMMERCIAL EMPLOYMENT GROWTH FACTORS

County	1974	1980	1985	2000
Dutchess	1.00	1.068	1.126	1.330
Nassau	1.00	0.989	0.999	1.092
Orange	1.00	1.148	1.271	1.618
Putnam	1.00	1.007	1.050	1.302
Rockland	1.00	1.057	1.105	1.272
Suffolk	1.00	1.079	1.147	1.286
Westchester	1.00	0.999	1.037	1.162

Step 18

The same emission factors as Step 14.

FAIRFIELD COUNTY

Steps 1 to 10

Omitted

Step 11

Data supplied by CONNDEP shows no residual oil used for commercial space heating in 1974.

A 3a NATURAL GAS - INDUSTRIAL

Update Level: 2 [pp. 61-64, Guidelines, Vol. 7]
Projection Level: 2 [p. 123, Guidelines, Vol. 7]
Allocation Order: 1 [pp.109-111, Guidelines, Vol. 13]

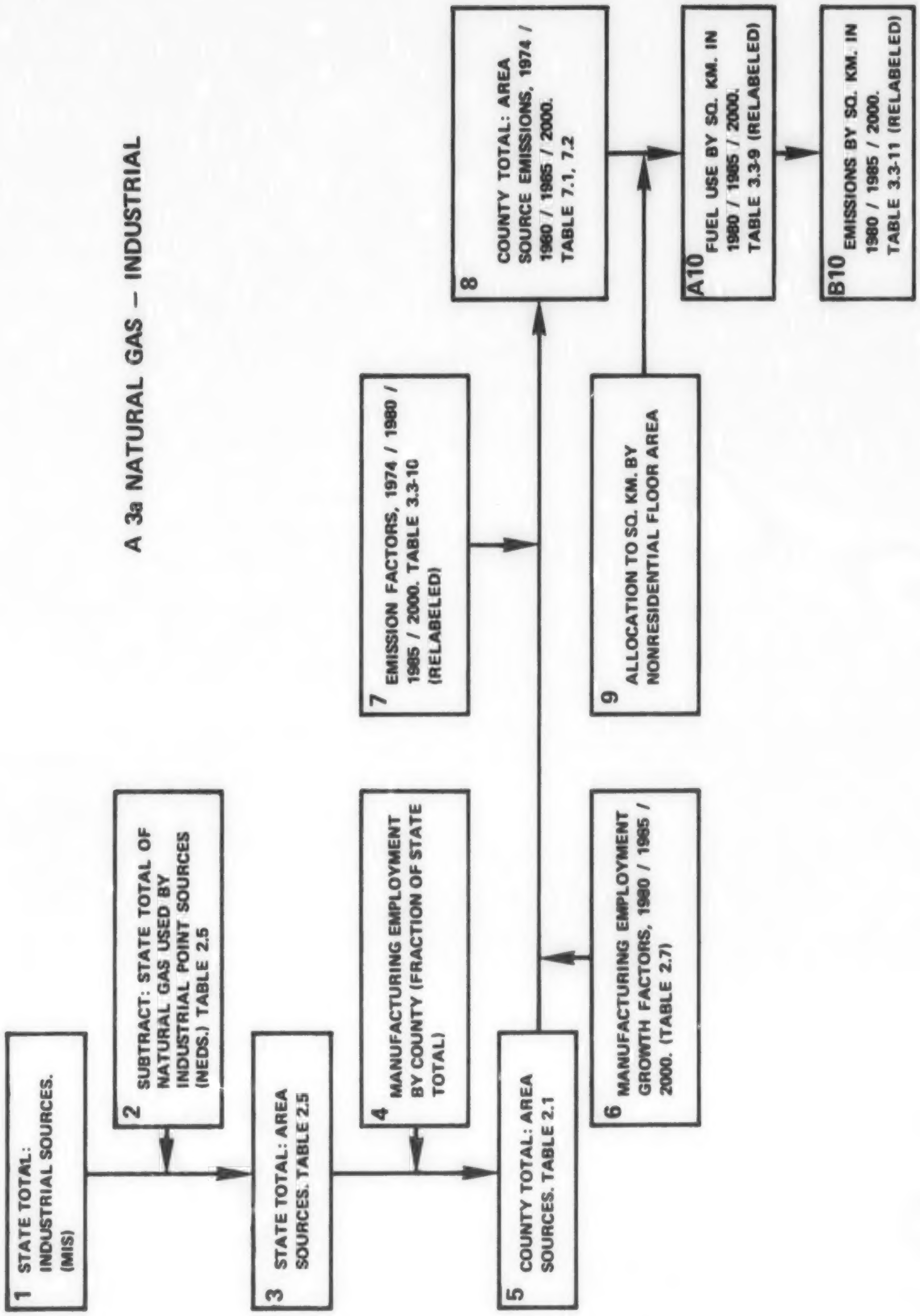
Substance and sequence of steps are given in the work chart. The following details are provided for those steps where procedures are not obvious.

NEW JERSEY

Steps 1 through 5 -- omitted

After manipulating state totals of natural gas by subtracting various categories of use, there was no natural gas left for area industrial sources. However, in the NEDS file, various listed activities were classified as area sources, and these were used to distribute "area" source natural gas usage. Employment as a distribution factor for 1974 was not involved.

A 3a NATURAL GAS – INDUSTRIAL


1 STATE TOTAL: INDUSTRIAL SOURCES. (MIS)
2 SUBTRACT: STATE TOTAL OF NATURAL GAS USED BY INDUSTRIAL POINT SOURCES (NEDS.) TABLE 2.5
3 STATE TOTAL: AREA SOURCES. TABLE 2.5
4 MANUFACTURING EMPLOYMENT BY COUNTY (FRACTION OF STATE TOTAL)
5 COUNTY TOTAL: AREA SOURCES. TABLE 2.1
6 MANUFACTURING EMPLOYMENT GROWTH FACTORS, 1980 / 1985 / 2000. (TABLE 2.7)
7 EMISSION FACTORS, 1974 / 1980 / 1985 / 2000. TABLE 3.3-10 (RELABELED)
8 COUNTY TOTAL: AREA SOURCE EMISSIONS, 1974 / 1980 / 1985 / 2000. TABLE 7.1, 7.2
9 ALLOCATION TO SQ. KM. BY NONRESIDENTIAL FLOOR AREA
A10 FUEL USE BY SQ. KM. IN 1980 / 1985 / 2000. TABLE 3.3-9 (RELABELED)
B10 EMISSIONS BY SQ. KM. IN 1980 / 1985 / 2000. TABLE 3.3-11 (RELABELED)

New Jersey cont.

Step 6

See Table, P 2./6 for manufacturing growth factors.

The methodology employed could not include the projection of classes of manufacturing employment by county. Please refer to Appendix V for a description of the projection methods used to forecast manufacturing employment by category of manufacturing.

Step 7

EMISSION FACTORS FOR INDUSTRIAL NATURAL GAS COMBUSTION

Pollutant	lb/10^6 cu.ft.
Particulates	10.0
Sulfur Oxides	0.6
Nitrogen Oxides	175.0
Hydrocarbons	3.0
Carbon Monoxide	17.0

Source: AP-42

NEW YORK CITY

Steps 1 through 4

Omit.

Step 5

County	Area source totals (10^6 cu. ft.)
Bronx	505
Kings	8,612
New York	2,954
Queens	2,809
Richmond	0

These data were supplied by the New York City Department of Air Resources. Methods used to develop these data are described in a series of technical reports issued by the Bureau of Technical Services.

New York City cont.

Step 6

See Table, P 2 /6, for manufacturing growth factors.

The methodology employed could not include the projection of manufacturing employment by county. Please refer to Appendix V for a description of the projection methods used to forecast manufacturing employment by category of manufacturing.

Step 7

. EMISSION FACTORS FOR INDUSTRIAL NATURAL GAS COMBUSTION

Pollutant	lb/10 cu.ft.
Particulates	10.0
Sulfur Oxides	0.6
Nitrogen Oxides	175.0
Hydrocarbons	3.0
Carbon Monoxide	17.0

Source: AP-42

Step 9

Same as method used in the New Jersey sector.

NEW YORK STATE

Steps 1 through 5

There was no natural gas used by industrial point sources, according to calculations of New York State Department of Environmental Protection. (See Appendix VI). However, certain sources listed in the NEDS file, classified as "area" sources through the arbitrary quantity cutoff, were used to distribute to the specific km^2 where the activities were located.

Step 6

See Table, P 2 /6, for manufacturing growth factors.

The methodology employed could not include the projection of manufacturing employment by county. Please refer to Appendix V for a description of the projection methods used to forecast manufacturing employment by category of manufacturing.

New York State cont.

Step 7

EMISSION FACTORS FOR INDUSTRIAL NATURAL GAS COMBUSTION

Pollutant	$lb/10^6$ cu.ft.
Particulates	10.0
Sulfur Oxides	0.6
Nitrogen Oxides	175.0
Hydrocarbons	3.0
Carbon Monoxide	17.0

Source: AP-42

Step 9

Same as method used in the New Jersey sector.

CONNECTICUT (Fairfield County)

Step 1

MIS = $16,100.\times10^6$ cu.ft. This datum was not used in subsequent calculations, but is recorded for possible use in checking the reasonableness of results.

Connecticut (Fairfield County) cont.

Step 5

Fuel use data were supplied by the CONNDEP at the MCD level. Methods used to develop this information are reported in "Appendix A, Connecticut Air Inventory Reference (CONNAIR), Department of Environmental Protection, Air Compliance Unit, Engineering Section."

Step 9

Same as method described in Step 9, New Jersey, A 2a /5.

A 3b DISTILLATE OIL - INDUSTRIAL

Update Level: 2 [pp. 62-63, Guidelines, Vol. 7]
Projection Level: 2 [p. 123, Guidelines, Vol. 7]
Allocation Order: 1 [pp. 109-11, Guidelines, Vol. 7]

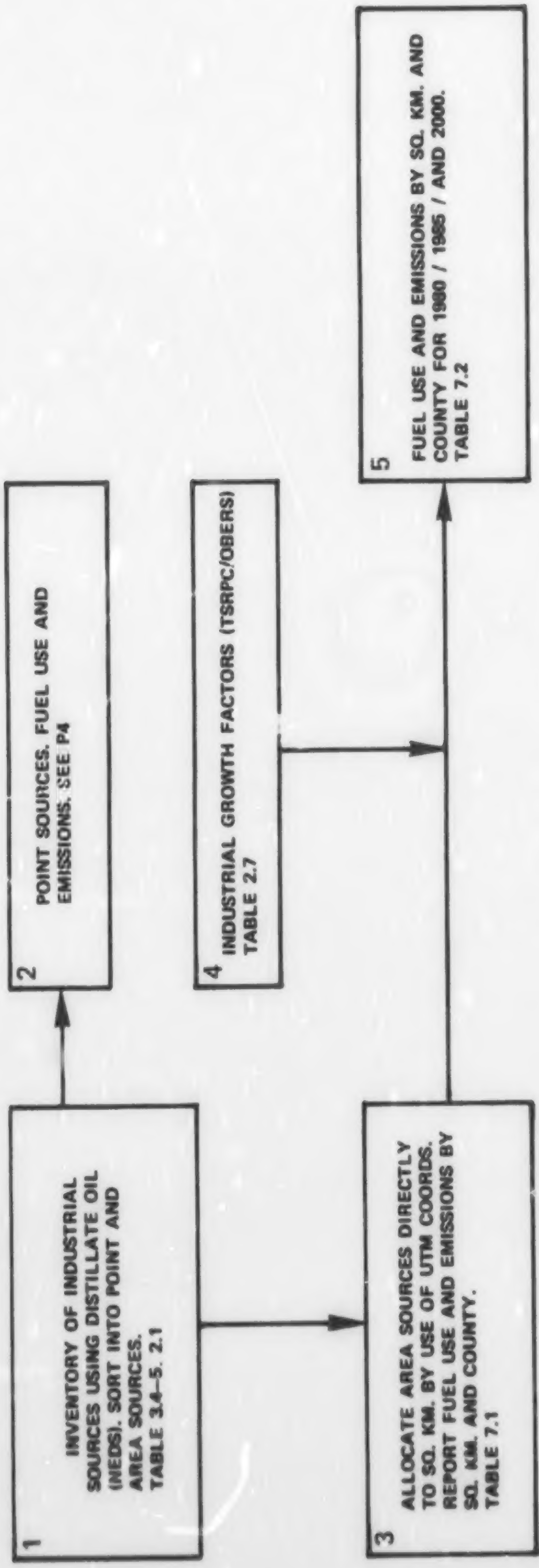
Substance and sequence of steps are given in the work chart. The following details are provided for those steps where procedures are not obvious.

NEW JERSEY

Step 1

Points using distillate oil within facilities emitting 100 T/Y or more of particulates or sulfur oxides are defined as point sources. Those with less than 100 T/Y of these pollutants are defined as area sources.

A 3b DISTILLATE OIL — INDUSTRIAL


1
INVENTORY OF INDUSTRIAL SOURCES USING DISTILLATE OIL (NEDS). SORT INTO POINT AND AREA SOURCES. TABLE 3.4–5. 2.1
2
POINT SOURCES. FUEL USE AND EMISSIONS. SEE P4
3
ALLOCATE AREA SOURCES DIRECTLY TO SQ. KM. BY USE OF UTM COORDS. REPORT FUEL USE AND EMISSIONS BY SQ. KM. AND COUNTY. TABLE 7.1
4
INDUSTRIAL GROWTH FACTORS (TSRPC/OBERS) TABLE 2.7
5
FUEL USE AND EMISSIONS BY SQ. KM. AND COUNTY FOR 1980 / 1985 / AND 2000. TABLE 7.2

New Jersey cont.

Step 4

The growth factor for fuel used in manufacturing is the Regional growth factor for manufacturing developed under P2--Industrial Processes Fuel Combustion, Steps 5 and 6.

	GROWTH FACTOR			
	1974	1980	1985	2000
Manufacturing	1.00	1.113	1.224	1.704

NEW YORK CITY

Steps 1 to 5

Same as New Jersey.

NEW YORK STATE

Step 1

Points using distillate oil within facilities emitting 25 T/Y or more of any one of particulate matter, SO_2 and HC are defined as point sources. Points emitting less than 25 T/Y of these pollutants are defined as area sources.

New York State cont.

Steps 2 to 5

Same as New Jersey.

CONNECTICUT (Fairfield County)

Steps 1 to 5

Quantities supplied by Connecticut Department of Environmental Protection and increased for target years were distributed by floor area. See New Jersey, A 2a / 5, for an explanation of the floor area distribution technique.

A 3c RESIDUAL OIL - INDUSTRIAL

Update Level: 2 [p. 61, Guidelines, Vol. 7]
Projection Level: 2 [p. 123, Guidelines, Vol. 7]
Allocation Order: 1 [p. 109, Guidelines, Vol. 13]

Substance and sequence of steps are given in the work chart. The following details are provided for those steps where procedures are not obvious.

NEW JERSEY

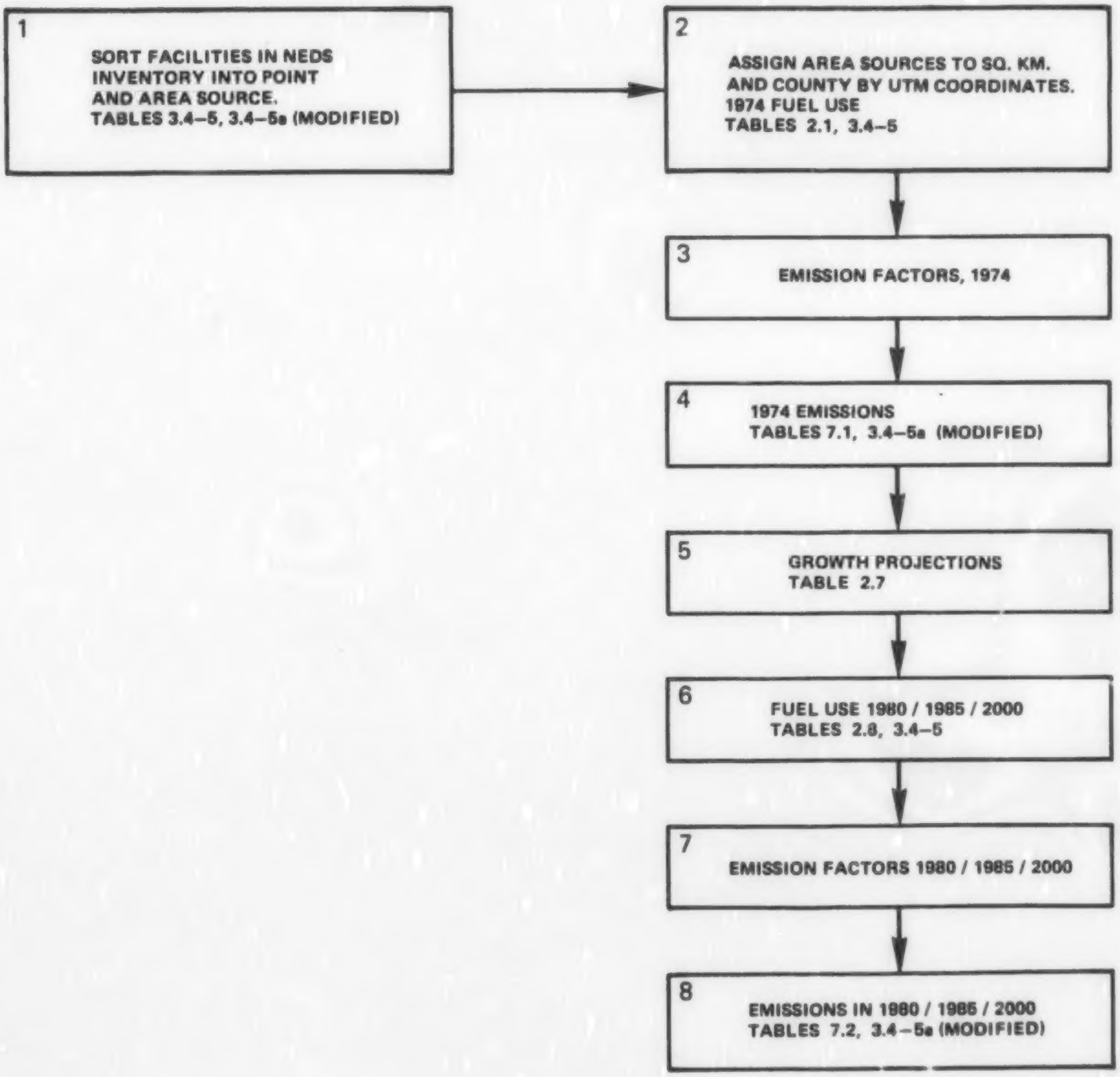
Step 1

Points using distillate oil within facilities emitting 100 T/Y or more of particulates or sulfur oxides are defined as point sources. Those with less than 100 T/Y of these pollutants are defined as area sources.

A 3c RESIDUAL OIL – INDUSTRIAL

(AREA SOURCE)

LEVEL : 2
ORDER : 1


1
SORT FACILITIES IN NEDS INVENTORY INTO POINT AND AREA SOURCE.
TABLES 3.4–5, 3.4–5a (MODIFIED)
2
ASSIGN AREA SOURCES TO SQ. KM. AND COUNTY BY UTM COORDINATES.
1974 FUEL USE
TABLES 2.1, 3.4–5
3
EMISSION FACTORS, 1974
4
1974 EMISSIONS
TABLES 7.1, 3.4–5a (MODIFIED)
5
GROWTH PROJECTIONS
TABLE 2.7
6
FUEL USE 1980 / 1985 / 2000
TABLES 2.8, 3.4–5
7
EMISSION FACTORS 1980 / 1985 / 2000
8
EMISSIONS IN 1980 / 1985 / 2000
TABLES 7.2, 3.4–5a (MODIFIED)

New Jersey cont.

Step 3

EMISSION FACTORS FOR INDUSTRIAL RESIDUAL OIL COMBUSTION

Pollutant	lb/10^3 gal
Particulates	6.0
Sulfur Oxides	157 S^a = 47.1
Nitrogen Oxides	60.0
Hydrocarbons	1.0
Carbon Monoxide	5.0

Source: AP-42

a. S = 0.3

Step 5

The growth factors for the manufacturing sector computed from OBERS, as modified by the TSRPC, are listed below.

Growth Factors			
1974	1980	1985	2000
1.00	1.113	1.224	1.704

See P 2/6 for details.

Step 7

Same emission factors as Step 3.

NEW YORK CITY

Step 2

Area source totals by county were supplied by the New York City Department of Air Resources. Methods used to develop these data are described in reports prepared by the Bureau of Technical Sources.

County	Area Source Totals (10^3 gal)
Bronx	6,700
Kings	33,500
New York	60,000
Queens	20,200
Richmond	13,167

Step 3

EMISSION FACTORS FOR INDUSTRIAL RESIDUAL OIL COMBUSTION

Pollutant	lb/10^a gal
Particulates	8.7
Sulfur Oxides	157 S^a = 45.0
Nitrogen Oxides	48.6
Hydrocarbons	.22
Carbon Monoxide	.8

Source: NYCDAR

a. S = 0.3

New York City cont.

Step 5

The same growth factors as New Jersey, Step 5.

Step 7

The same emission factors as Step 3.

NEW YORK STATE

There was no residual oil left for area industrial sources. However, the NEDS entries classed as "area" sources were used to allocate the amounts estimated for these for the target years.

New York State cont.

Step 3

EMISSION FACTORS FOR INDUSTRIAL RESIDUAL OIL COMBUSTION

	Rockland, Westchester, Nassau	(Western)[b] Suffolk	Eastern Suffolk[d] and Orange, Putnam, Dutchess
Pollutant	lb/10^3 gal	lb/10^3 gal	lb.10^3 gal
Particulates	6.7	13.0	23.
Sulfur Oxides	157 S^a = 58.1	157 S^c = 157.0	157 S^e = 314.
Nitrogen Oxides	60.0	60.0	60.0
Hydrocarbons	1.0	1.0	1.0
Carbon Monoxide	5.0	5.0	5.0

Source: AP-42

a. S = 037

b. Towns of Babylon, Brookhaven, Huntington, Islip, and Smithtown.

c. S = 1.00

d. Towns of Easthampton, Riverhead, Shelter Island, Southampton, Southold.

e. S = 2.00

Step 5

The same growth factors as in New Jersey, Step 5.

Step 7

The same emission factors as Step 3.

FAIRFIELD COUNTY

Step 1

The same definitions of point and area sources as New York State.

Step 2

There was no residual oil used by industrial sources in 1974, according to the CONNDEP. It is assumed that the same will hold true for all future years.

A 4 ONSITE INCINERATION

Update Level: 3 [p. 75, Guidelines, Vol. 7]

Projection Level: 1 or 2 [p. 118 or p. 133, Guidelines, Vol. 7]

Allocation Order: 2 or 3 [p. 125 or p. 127, Guidelines, Vol. 13]

Substance and sequence of steps are given in the work chart. The following details are provided for those steps where procedures are not obvious.

A 4a RESIDENTIAL

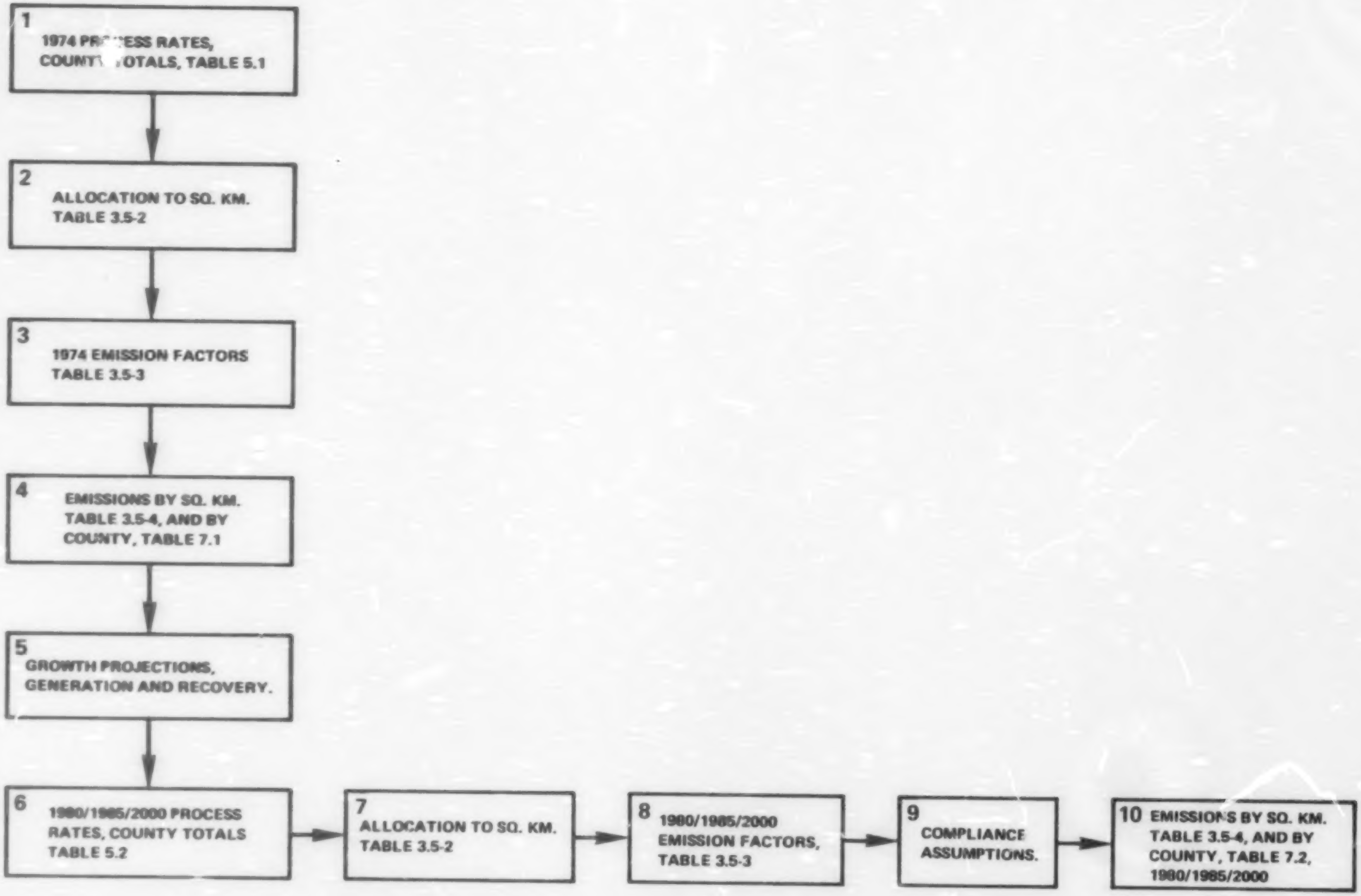
NEW JERSEY

Steps 1 and 2

Residential on-site incineration is permitted by the New Jersey Administrative Code, Title 7, Chapter 27, Subchapter 11, Incinerators, which requires that incinerators be multiple chamber. The provisions of this Subchapter do not apply to incinerators installed or used in one or two-family dwellings or multi-occupied dwellings containing six or less family units and having one owner occupied.

A 4. ONSITE INCINERATION (RESIDENTIAL, COMMERCIAL, INDUSTRIAL)

(AREA SOURCES)


1 1974 PROCESS RATES, COUNTY TOTALS, TABLE 5.1
2 ALLOCATION TO SQ. KM. TABLE 3.5-2
3 1974 EMISSION FACTORS TABLE 3.5-3
4 EMISSIONS BY SQ. KM. TABLE 3.5-4, AND BY COUNTY, TABLE 7.1
5 GROWTH PROJECTIONS, GENERATION AND RECOVERY.
6 1980/1985/2000 PROCESS RATES, COUNTY TOTALS TABLE 5.2
7 ALLOCATION TO SQ. KM. TABLE 3.5-2
8 1980/1985/2000 EMISSION FACTORS, TABLE 3.5-3
9 COMPLIANCE ASSUMPTIONS.
10 EMISSIONS BY SQ. KM. TABLE 3.5-4, AND BY COUNTY, TABLE 7.2, 1980/1985/2000

A 4a Residential cont. (N.J.)

It is virtually impossible to estimate process rates for the exceptions described above. Therefore, the only incineration sources which can be estimated are those with permits listed in N.J. NEDS file. Process rates were allocated directly to their respective square kilometers using the source's U.T.M. coordinates.

NEW YORK CITY

Steps 1 and 2

Regulations concerning refuse burning equipment and refuse compacting systems are contained in the Administrative Code of the City of New York, Chapter 57, Part II, Article 4, and in Article 9, dealing with emission standards. Chapter 57 became effective August 25, 1971. The relevant sections of Article 4 are listed below:

Existing Refuse Burning Equipment

Refuse burning equipment in operation after January 1, 1965, could remain in operation or, if discontinued, be replaced by a compactor. Under certain conditions, discussed below, an operator of an incinerator could shut the incinerator down and not replace it with a compactor. These special cases occurred:

1. Upon the application of any owner of refuse burning equipment in a multiple dwelling unit containing 42 dwelling units or less per unit of refuse burning equipment, provided that the applicant showed to the satisfaction of the administrator that it would not be reasonably practicable for the applicant to cause the equipment in such multiple dwelling to fully meet the (emission) standards of this code, or to install a reasonably efficient refuse compacting system, by reason of the physical characteristics of the multiple dwelling.

A 4a Residential cont. (N.Y.C. Steps 1 and 2)

2. Upon the application of any owner of refuse burning equipment in a public building, in a public housing project operated by the New York city housing authority containing 42 or less dwelling units, in a building operated by a charitable or non-profit institution, or in a building utilized solely for trade, business or professional occupancy.

Installation of refuse burning equipment, other than municipal, prohibited; new installation.

a. No person shall permit the installation of refuse burning equipment, except in

(1) hospitals

(2) public sewage treatment plants and solid waste disposal.

Therefore, at sites where on-site incineration occurred in 1971 operators could choose among the following alternatives

1. *Continue incineration and upgrade*
2. *Continue incineration and not upgrade (not in compliance)*
3. *Convert to compactors*
4. *Discontinue incineration (and not install compactors)*

The New York City Department of Air Resources, as of December 31, 1975, estimated the following breakout for 17,000 on-site incinerators:

1. Continue incineration and upgrade = 3,705
2. Continue incineration and not upgrade = 2,119
3. Convert to compactors = 8,075
4. Discontinue incineration = 2,791

Therefore, both the upgraded and nonupgraded incinerators had to be allocated to square kilometers, consistent with the regulations related to structure sizes described above.

A 4a Residential cont. (N.Y.C.)

Step 3

EMISSION FACTORS FOR FLUE FED APARTMENT HOUSE INCINERATORS

	Status of Incinerator	
Pollutant	Unupgraded lb/ton refuse	Upgraded lb/ton refuse
Particulates	30.	6.0
Sulfur Oxides	0.5	0.5
Nitrogen Oxides	20.0	10.0
Hydrocarbons	15.	3.
Carbon Monoxide	3.0	10.

Source: New York City Department of Air Resources

Although these are actually residential , emissions from apartments have been reported under Commercial/Institutional (Tables 5.1 and 5.2).

Step 5

Increases in residential solid waste were based on growth in population estimated to dwell in incinerator-served buildings for the target years. Such increases evolved from estimations regarding:

a. What proportion of relevant NYC Department of Real Estate building categories would have incinerators.

b. The square footage of each category obtained by Tri-State calculations of data in DRE files for its 1963 Land Use Inventory.

c. The square foot-per-person factors derived from Tri-State empirical floor area studies.

d. The estimated population residing in these buildings by borough and the proportion to the total population by borough.

e. The application of these proportions to projected borough populations.

f. Derivation of growth factors by borough.

Following are the assumptions regarding building categories and sq.ft. factors:

	DRE Category	# of buildings, 1963	sq.ft. per pers.
100% Calculated	D1	5,142	411
	D3	1,807	641
	D4	676	758
	D6	362	641
	D8	539	411
	D0	1,346	341
50% Calculated	C1	4,448 (net)	372
	C8	1,841 (net)	372
		16,161	

Step 9

It was assumed that sources not in compliance in 1974 would achieve compliance in 1980.

A 4a Residential cont.

NEW YORK STATE

Steps 1 and 2

Incineration in New York State is regulated under Part 219, Incinerators, and Part 222, Incinerators - New York City, Nassau, and Westchester counties, of Title 6, Chapter III, of the Official Compilation of Codes, Rules and Regulations of the State of New York.

All on-site incineration was calculated from data on smaller sources in the New York State [Point Source] Inventory. Process rate and emission data were assigned to square kilometers using the U.T.M. coordinates of the source.

Step 3

Emission factors in the New York State [Point Source] Inventory were obtained from either AP-42 or stack test data.

Step 5

Growth factors were calculated from population growth at the county level. See Appendix IV

Step 9

It was assumed that sources not in compliance in 1974 would achieve compliance before 1980.

A 4b ON-SITE INCINERATION--COMMERCIAL

NEW JERSEY

Steps 1 and 2

Codes dealing with the regulation of incineration are listed in the Residential section (A 4a). Process rates were obtained from the NEDS point source inventory. Process rates for "listed" area sources were allocated to square kilometers by using the U.T.M. coordinates of the sources.

No further calculations were carried out because of lack of input data such as process rates.

NEW YORK CITY

Step 1

The 1974 county total process rate was approximately zero, according to information from the New York City Department of Air Resources. No change was foreseen. However, emissions from apartments have been reported under Commercial/Institutional (Tables 5.1 and 5.2). See A 4/6.

A 4b On-Site Incineration--Commercial cont.

NEW YORK STATE

Steps 1 and 2

Codes dealing with the regulation of incineration are listed in the Residential section of A 4. Process rates were obtained from the New York State [Point Source] Inventory.

Step 5

Growth factors were estimated from the commercial/institutional sector growth factor of the OBERS projections, as modified by the TSRPC. See A 2 b/17 for quantities.

Step 9

It was assumed that sources not in compliance in 1974 would achieve compliance before 1980.

A 4c ON-SITE INCINERATION--INDUSTRIAL

NEW JERSEY

Steps 1 and 2

Codes dealing with the regulation of incineration are listed in the Residential section (A 4a). Process rates were obtained from the NEDS point source inventory. Process rates for listed "area" sources were allocated to square kilometers by using the U.T.M. coordinates of the sources. For non-listed area sources, no calculations were made because of lack of input data.

NEW YORK CITY

Step 1

The 1974 county total process rate was approximately zero, according to information from the New York City Department of Air Resources.

NEW YORK STATE

Steps 1 and 2

Codes dealing with the regulation of incineration are listed in the Residential section (A 4a). Process rates were obtained from the New York State

A 4c On-Site Incineration--Industrial cont. N.Y.S.

[Point Source] Inventory. Process rates and emissions of listed "area" sources were allocated to square kilometers by using the U.T.M. coordinates of the sources.

Step 5

Growth factors were estimated from the manufacturing sector growth factors in the OBERS projections, as modified by the TSRPC (See P 2/3 Industrial Processes).

1974	1980	1985	2000
1.00	1.113	1.224	1.704

Step 9

It was assumed that sources not in compliance in 1974 would achieve compliance before 1980.

A 6 DIESEL LOCOMOTIVES

Level: 1, 2, 3 identical (pp.115 Guidelines, Vol.7)

Order: 1, 2, 3 identical (pp.60-61, Guidelines, Vol.13)

METHOD

Refer to chart for sequence of steps. The following will give details for those steps where procedures are not obvious.

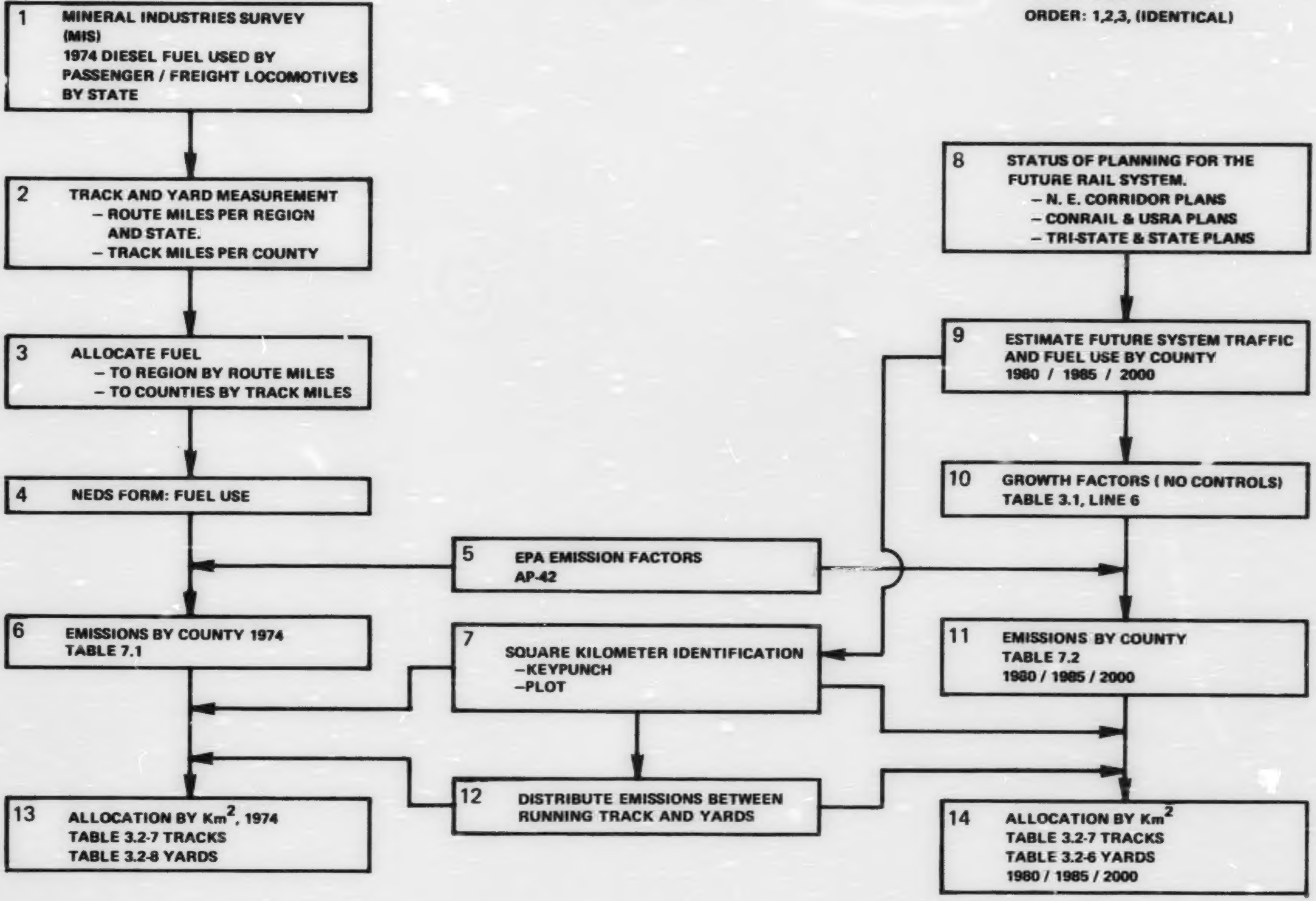
Step 2 Track and Yard Measurement

Statewide 1974 diesel locomotive fuel consumption totals from the Mineral Industries Survey were allocated to the Tri-State Region portion of the States and to the counties by using measured track and route miles. The Region's railroad track mileage was estimated using a combination of railroad operations and Tri-State documents and map or valuation sheet reconnaissance. Multiple track lines were identified, then the lines or branches were researched to obtain mileage distances. Maps were measured to provide accuracy checks. Electrically operated rail lines with no diesel locomotive traffic were

A6 – DIESEL LOCOMOTIVES

(AREA SOURCE)

LEVEL: 1,2,3, (IDENTICAL)
ORDER: 1,2,3, (IDENTICAL)


1 MINERAL INDUSTRIES SURVEY (MIS) 1974 DIESEL FUEL USED BY PASSENGER / FREIGHT LOCOMOTIVES BY STATE
2 TRACK AND YARD MEASUREMENT – ROUTE MILES PER REGION AND STATE. – TRACK MILES PER COUNTY
3 ALLOCATE FUEL – TO REGION BY ROUTE MILES – TO COUNTIES BY TRACK MILES
4 NEDS FORM: FUEL USE
5 EPA EMISSION FACTORS AP-42
6 EMISSIONS BY COUNTY 1974 TABLE 7.1
7 SQUARE KILOMETER IDENTIFICATION –KEYPUNCH –PLOT
8 STATUS OF PLANNING FOR THE FUTURE RAIL SYSTEM. – N. E. CORRIDOR PLANS – CONRAIL & USRA PLANS – TRI-STATE & STATE PLANS
9 ESTIMATE FUTURE SYSTEM TRAFFIC AND FUEL USE BY COUNTY 1980 / 1985 / 2000
10 GROWTH FACTORS (NO CONTROLS) TABLE 3.1, LINE 6
11 EMISSIONS BY COUNTY TABLE 7.2 1980 / 1985 / 2000
12 DISTRIBUTE EMISSIONS BETWEEN RUNNING TRACK AND YARDS
13 ALLOCATION BY Km², 1974 TABLE 3.2-7 TRACKS TABLE 3.2-8 YARDS
14 ALLOCATION BY Km² TABLE 3.2-7 TRACKS TABLE 3.2-6 YARDS 1980 / 1985 / 2000

eliminated from consideration. Major rail yards and engine terminals were identified and their size estimated by measuring USGS maps, and Tri-State aerial photographs.

Step 3 Allocate 1974 Fuel to Region and Counties

Mineral Industry Survey fuel sales (consumption) by states were distributed to the Tri-State Region by allocating fuel in the same proportion as railroad route mileage. For more critical fuel allocation down to county level, the track mile proportion between region and county by state is used. Tables I and II (in Tri-State files) outline these procedures. These methods assume that there is a positive relationship between route miles on a state basis or track miles on a regional basis and railroad locomotive activity or fuel consumption. This is a reasonable assumption as long as it applied on a state/regional scale.

Steps 5 and 6 EPA Emission Factors Applied to County Fuel Data

Emission factors found in AP-42 were applied to the diesel locomotive fuel consumption by county. This procedure furnished the 5 major emission types (Particulates, SO_x, NO_x, HC, and CO) in tons per year by county. Later steps use this same procedure to estimate future year emissions by type and county. These data were entered on EPA Table 7.1 (future year 7.2) and are summarized on Table IIIA (in Tri-State files).

Step 7 Identify Square Kilometers

A square kilometer grid was superimposed on the regional rail system map. Diesel-operated rail lines and yards previously identified in Step 2 were located on the latter. Square kilometers (Km^2) which these rail facilities pass through or abut directly were then identified on the map and their coordinates recorded for keypunching. Square kilometer coordinates impacted by the base year (1974) rail system were punched and then plotted to enable not only accuracy checks, but also adaptation of future year changes to the rail system. Figure VIII (attached) shows a portion of this plot.

Step 8 Status of Planning for Future Rail Systems

Under federal mandate, the three states of the region have prepared their own statewide rail plans. These state plans, the Final System Plan (FSP) and the Tri-State Rail Freight Plan constitute major sources for determining the county shares of the region's rail system for future years.

Connecticut State Rail Plan - Phase II (Draft), Connecticut Department of Transportation, October 1975.

Final System Plan (FSP) Volume 1, United States Railway Association (USRA), February 26, 1975.

New Jersey State Rail Plan - Phase II, New Jersey Department of Transportation, December 9, 1975.

New York State Rail Plan, New York State Department of Transportation, November 1975.

Regional Rail Freight, 1974 and the Future, Tri-State Regional Planning Commission, March 1974.

Step 9 Estimate Future Rail System Traffic and Fuel Use

The United States Railway Association (USRA) estimated growth in rail traffic as part of their development of their Final System Plan (FSP). This source was used to estimate the growth in rail activity as a measure of change in locomotive fuel consumption for EPA target years 1980, 1985, and year 2000. Volume I of the FSP states "Freight tonnage is expected to increase from 352.2 million tons in 1973 to 416.8 in 1985 (340.29 in 1974). This growth was forecast using data on thirteen major commodity groups. The Association (USRA) sees a compound growth rate 1.41 between 1973 and 1985." This growth rate was extended from 1985 to year 2000 for this study.

Steps 10 and 11 Growth Factors Applied to Estimate Emissions By County

Traffic (locomotive activity) growth factors were applied to estimate locomotive fuel consumption in 1980, 1985, and year 2000. The base year 1974 locomotive fuel use had been estimated earlier in steps 3 and 4. The EPA Emission factors (AP-42) were applied to future county fuel use to derive the five emission types by county in the same manner as for the base year in step 6. The five emission types were entered on EPA table 7.2 for future years.

Step 12 Distribute Emissions to Track and Yards

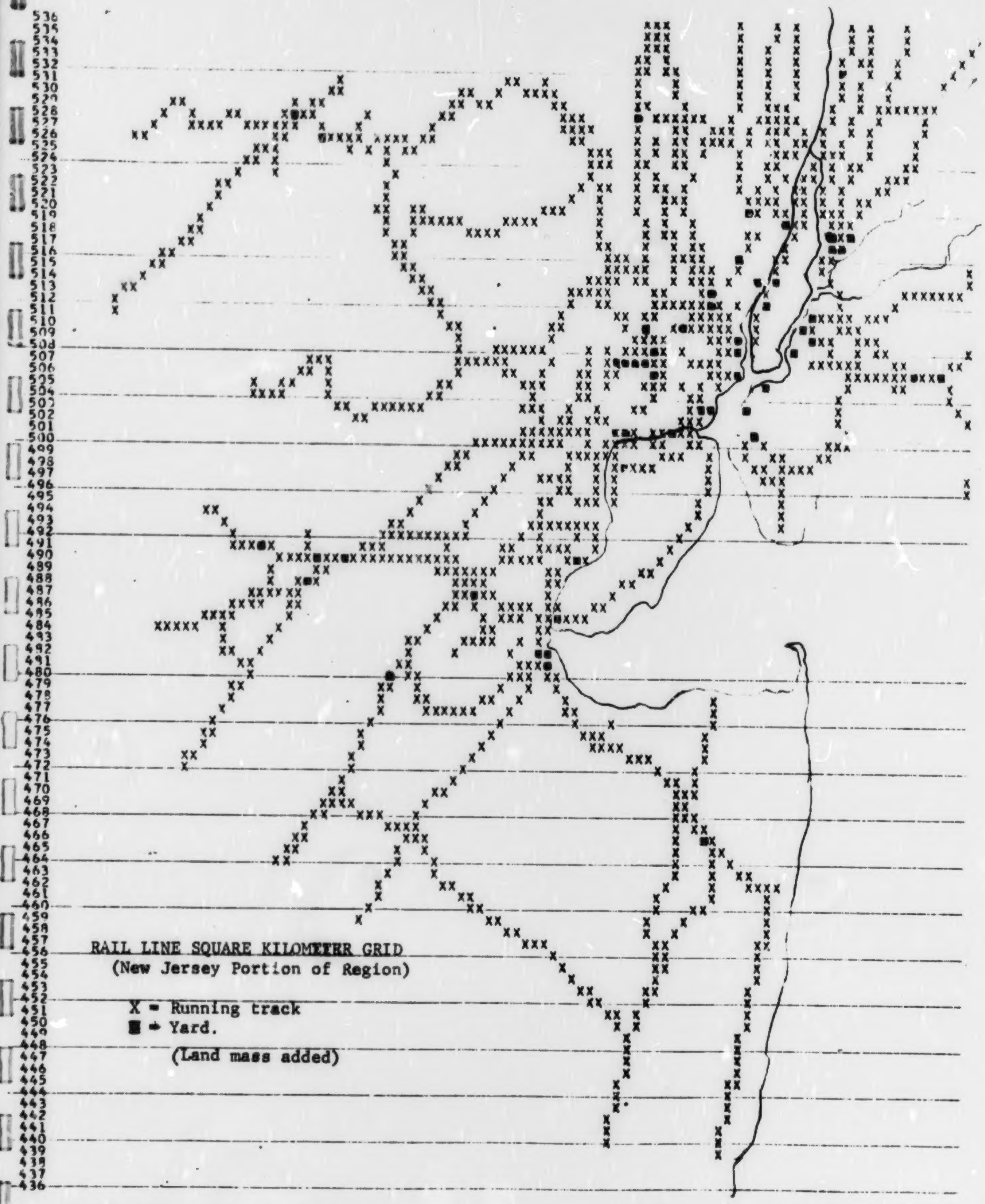
Prior to accomplishing this step, the changes in the rail system for 1980, 1985, and year 2000 identified in step 8 were transferred to the square kilometer grid. Square kilometers of branch lines added or deleted in future years were recorded by their square kilometer grid coordinates and punched and plotted to ease identification of errors and implementation of corrections.

Electronic data processing procedures were used to distribute emissions between running track Km^2 and yard Km^2 by county. In the manual, EPA suggested doubling the weight of yards vs. running tracks and this modification was used. The valid assumption is that yards are more intensively used than running track.

Steps 13 and 14 Allocate to Square Kilometers Base and Future Years

This process was accomplished by the computer. The allocation was uniform within each county, using the county wide emission totals as control. The yard Km^2 were accorded double the weight of running tracks as mentioned in Step 12. Some consideration was given to weighting multiple track lines with a heavier allocation of emissions than single track lines. But the allocation was by route miles rather than track miles. In other words, allocation was by Km^2 rather than by tracks. There are two reasons for this decision: First, the number of tracks is not necessarily related to the capacity or amount of traffic. Advanced technology has provided signalling and centralized traffic control which reduces the need for multiple trackage. In addition, the heaviest multiple track lines in this Region have substantial electrically propelled train movements.

A 6 / 7



RAIL LINE SQUARE KILOMETER GRID
(New Jersey Portion of Region)

X = Running track
■ = Yard.

(Land mass added)

A 7 SEA VESSELS

Level: 3 [pp. 93-94, Guidelines, Vol. 7]
Order: Channel/Terminal Location

Substance and sequence of steps are given in the work chart. The following details are provided for those steps where procedures are not obvious.

Step 2

Commercial Movements -

1. Obtain the number of vessels using Tri-State channels.

Section 2 of Part 1 of Waterborne Commerce of the United States - 1974 by the Department of the Army Corps of Engineers was used to obtain the number of vessels entering [not also departing] the channels of the New York and New Jersey counties of the Tri-State Region. Judgement was used to split channels bordering more than one county.

For each channel vessel movements for self-propelled categories were broken out to show drafts of up to 18 feet, and drafts of over 18 feet. Vessel movements for two installations in Suffolk County, at Northport and Northville, which are not covered by Corps of Engineers data, were included.

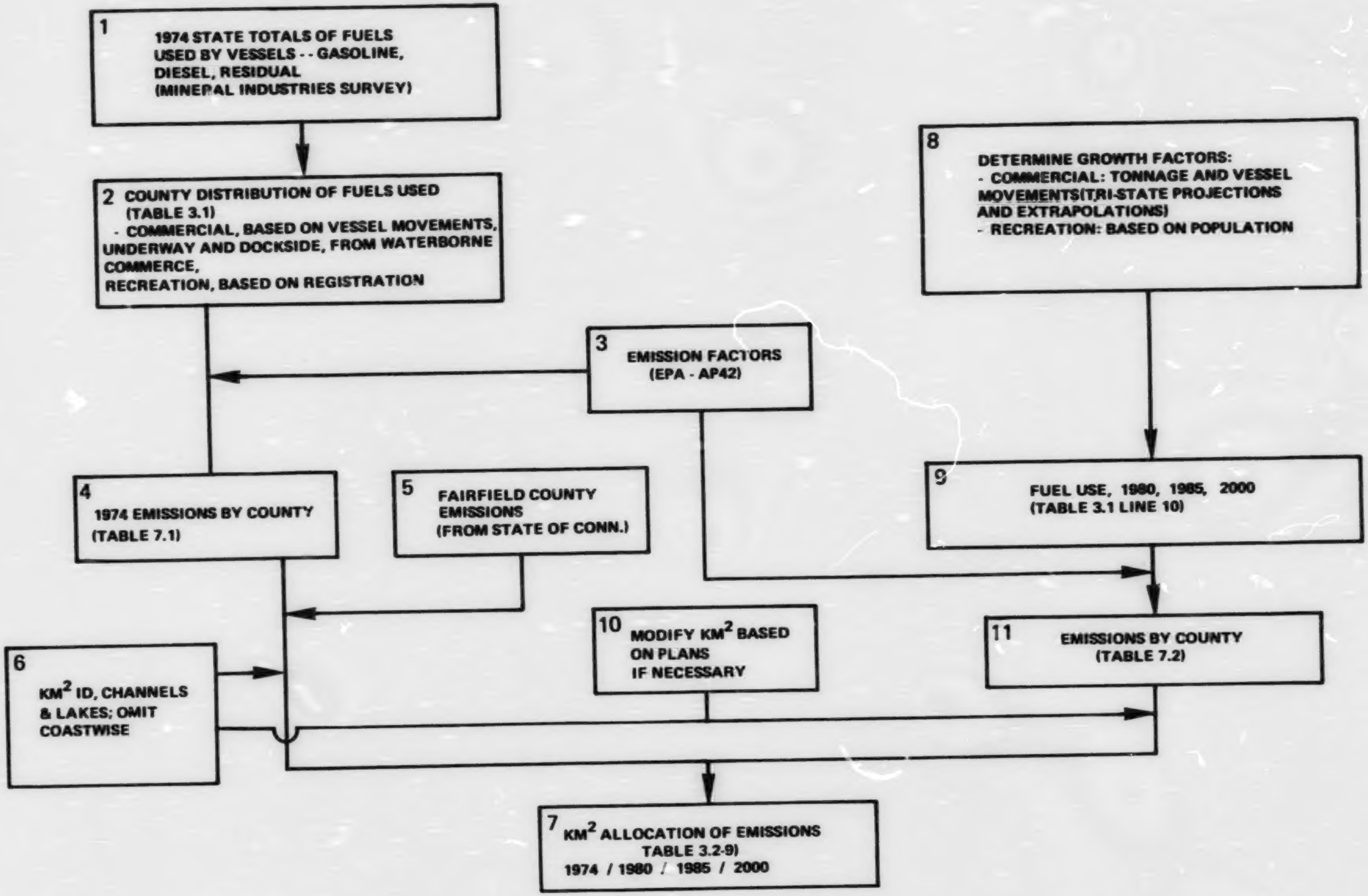
2. Calculate "In Port" Consumption of Fuel

A weighted average of 2 days at dock was worked out from information supplied by the Port Authority.

A7 SEA VESSELS

(MISC. AREA SOURCE)

LEVEL: 3
ORDER: CHANNEL/TERMINAL LOCATION



1 1974 STATE TOTALS OF FUELS USED BY VESSELS - - GASOLINE, DIESEL, RESIDUAL (MINERAL INDUSTRIES SURVEY)
2 COUNTY DISTRIBUTION OF FUELS USED (TABLE 3.1) - COMMERCIAL, BASED ON VESSEL MOVEMENTS, UNDERWAY AND DOCKSIDE, FROM WATERBORNE COMMERCE, RECREATION, BASED ON REGISTRATION
3 EMISSION FACTORS (EPA - AP42)
4 1974 EMISSIONS BY COUNTY (TABLE 7.1)
5 FAIRFIELD COUNTY EMISSIONS (FROM STATE OF CONN.)
6 KM² ID, CHANNELS & LAKES; OMIT COASTWISE
7 KM² ALLOCATION OF EMISSIONS TABLE 3.2-9) 1974 / 1980 / 1985 / 2000
8 DETERMINE GROWTH FACTORS: - COMMERCIAL: TONNAGE AND VESSEL MOVEMENTS(TRI-STATE PROJECTIONS AND EXTRAPOLATIONS) - RECREATION: BASED ON POPULATION
9 FUEL USE, 1980, 1985, 2000 (TABLE 3.1 LINE 10)
10 MODIFY KM² BASED ON PLANS IF NECESSARY
11 EMISSIONS BY COUNTY (TABLE 7.2)

Using the suggested formula, vessel days in port were distributed to residual and diesel users, and this was then multiplied by the use factor suggested for each type of fuel, yielding "In Port" consumption, by county:

New York State:

Sales of Residual Oil for vessels [Mineral Industries Surveys]

1974 - 10,676,000 barrels X 42 = 448,392,000 gal.

$$\frac{448,392,000}{1,900 \text{ gal./day}} = 235,995 \text{ vessel days}$$

Sales of Distillate [Diesel] oil for vessels [MIS]

1974 - 1,005,000 barrels X 42 = 42,210,000 gal.

$$\frac{42,210,000}{660 \text{ gal./day}} = 63,955 \text{ vessel days}$$

Residual	235,995	79%
Diesel	63,955	21%
Total Vessel Days	299,950	100%

New Jersey State:

Sales of Residual Oil for vessels [MIS]

1974 - 4,044,000 barrels X 42 = 169,848,000 gal.

$$\frac{169,848,000}{1,900 \text{ gal./day}} = 89,400 \text{ vessel days}$$

Sales of Distillate [Diesel] oil for vessels [MIS]

1974 - 1,754,000 barrels X 42 = 73,668,000 gal.

$$\frac{73,668,000}{660 \text{ gal./day}} = 111,618 \text{ vessel days}$$

Residual	89,400	44%
Diesel	111,618	56%
Total Vessel Days	201,018	100%

Number of vessels with draft over 18 feet entering channel, X two days in port; distribution of vessel days to residual and diesel as shown above; X use factor of 1,900 gal. for residual and 660 gal. for diesel yields number of gallons consumed in port, by type of fuel, by county.

3. Calculate "Underway" Consumption - Diesel Fuel Only

Tonnages handled were listed for 1974 from Waterborne Commerce of the U.S. Sec. 1 of Part 1 for all channels in the States of N.Y. and N.J. Distribution by county was made for the TSR portion. The percent that each county's tonnage bears to its State total was calculated. After subtracting the sum of the "in port" diesel fuel consumption previously calculated from the State total, the balance was distributed to the Tri-State counties according to share of tonnage handled.

	New York	New Jersey
Sales of Distillate for Vessels - 1974 [MIS]	1,005,000 barrels	1,754,000 barrels
X 42 gal./barrel =	42,210,000 gals.	73,668,000 gals.
Less "In Port" consumption	5,151,000 gals.	4,112,000 gals.
Balance to be distributed to TSR counties according to share of tonnage handled	37,059,000 gals.	69,556,000 gals.

RECREATION USE

For New York State, motorboat registrations by county of predominant use were obtained from the Department of Motor Vehicles for the counties of our interest. Data is collected for New York City as a whole, and this we apportioned among the five New York City counties according to share of the City's population.

New Jersey data are collected by Division of Motor Vehicles for the Trenton Main Office and four other district offices in the State. Registrations were apportioned to the counties of our interest on the basis of inland water surface area, as determined from the Bureau of the Census Area Measurement Reports.

The number of motorboat registarations thus determined was multiplied by the use factor of 160 gallons to arrive at gasoline consumption for the counties of our interest for 1974.

Step 3

County fuel use by type of fuel was multiplied by the following factors from AP 42:

Emmissions lb/10^3 gal.	Commercial Vessels		Pleasure Craft Gasoline[a]	
	Diesel In Port & Underway Table 3.2.3-1	Residual In Port "Hoteling" Table 3.2.3-2	In-board 3.2.3-5	Out-board 3.2.4-1
Sulfur oxides [SO_x]	27	47.7[b]	6.4	6.4
Carbon monoxide [CO]	110	Neg.	1240	3300
Hydrocarbons [HC]	50	3.2	86	1100
Nitrogen oxides [NO_x]	270	36.4	131	6.6
Particulates	-	10.0	-	-

[a] More detailed data on motorboat registrations from the State Motor Vehicle Agencies indicate that New York State 14% were inboard and 86% were outboard motors, while for New Jersey 20% were inboard and 80% were outboard.

[b] In 1974 residual fuel used in this area was .3% Sulphur.

Step 4

The above calculations yield emissions in pounds. This was converted to tons [2000 lbs.]

Step 5

Connecticut

A packet of information received from Conn. Dept. of E.P. contained printouts for each town in Fairfield County showing quantity of fuel used for vessels for 1973. Conversation with Mr. Freeto indicated the following usage:

Tugs & Ferries	- distillate [diesel]
Ships in berth	- residual
Ships underway	- distillate [diesel]
Gasoline powered	- gasoline

Fuel used was aggregated by type of fuel, and the same emission factors we used for New York and New Jersey were applied. This yielded emissions, in tons, by type of fuel for particulates, SO_x, CO, HC, and NO_x. In a table included in the Fairfield County packet, emissions for the county, not broken out by type of fuel, shows CO about 10% higher than the figure we arrived at, and HC 4% higher than our figure. [No emissions were shown for the other three elements.] A decision was made to use the higher Connecticut figures for CO and HC. We apportioned the Connecticut CO and HC figures to types of fuel according to the ratio from our calculations in order to meet the requirements of Form 7.1.

The emissions for CO and HC supplied by Conn. Dept. of E.P. were for 1973, 1975, 1978 and 1985. We interpolated to arrive at the figures for 1974, the base year. The growth rates arrived at for the two elements were used to project from 1973 to 1974 for the remaining three elements.

There are several methodologies available for preparing a vessel emission inventory. TSRPC chose a level that was consistent with AP 42 documentation, had prior approval by EPA, and was applicable for use over the entire region. The CONNAIR inventory chose a slightly different methodology to compute emissions from vessels. [Documented in Appendix A Connecticut Air Inventory Reference [CONNAIR] DEP Air Compliance Unit, Engineering Section.] Thus, since fuel use computations are similar, the difference between the CONNAIR and TSRPC values for TSP and NO_x appear to be a result of differing emission computation methods. Differences between values for the other pollutants are negligible.

Step 6

Using the Port Authority's Port District Map and a TSRPC 10-mile grid map with the XY coordinate system, every fourth grid in the Region's channels was listed. Then greater weight was given by adding km^2's to channel entrances and areas where heavy activity is known to exist, such as at the Port Newark-Elizabeth Channels. The percent each channel's vessel activity bears to the county total vessel activity was calculated. [Chan/Cty %] This figure was then divided by the number of km^2's listed for the channel to the third decimal [activity proportion]. The activity proportion was then applied to the county's total vessel emissions by type and kind of fuel. [Table 3.2-9]

Emissions distribution in the Ocean and Long Island Sound was omitted as there is no high-sea movement data for calculating fuel use.

Step 8

Information received from MARAD in Washington indicated waterborne commerce would increase nationwide by 278% from 1974 to year 2000. For this Region, such growth appeared to be invalid.

An unpublished forecast from the Port Authority indicates national waterborne and airborne foreign commerce is expected to increase by 66% during the period 1970 to 1990. The P.A.'s forecast for the Port's ocean and air foregn trade indicates an increase of about 71%, 1990 over 1970.

A Tri-State forecast made in 1973 indicated TSR domestic oceanborne and foreign waterborne commerce is expected to increase by only about 80% for the period 1975 to the year 2000. Furthermore, Tri-State found an overall increase of only 56% in domestic and foreign commerce at the PONY over the past 25 years [1950-1975]. The Tri-State forecast is in general agreement with the Port Authority's. The Project Officer agreed that Tri-State's projections should be used.

Growth rates obtained from these projections were applied uniformly to the counties affected.

Recreational Vessels

Growth rates for gasoline consumption for recreational vessels follow the rates established by Tri-State planning for most likely population targets for planned growth to the year 2000. These growth rates were applied to 1974 baseline emissions to produce estimates for target years.

A 8 AIRCRAFT EMISSIONS

Level: Predominantly 3 (p.144, Guidelines, Vol.7)
Order: not numbered (pp.59-60, Guidelines, Vol.13)

METHOD

Refer to chart for brief description and sequence of steps. The following notes will supply details for steps where procedures are not obvious. In addition, detailed notes for individual airports were prepared, since inputs and assumptions differ among them.

Emissions from ground operation vehicles (at the airports) are calculated in the category of off-highway vehicles (See Task A9b).

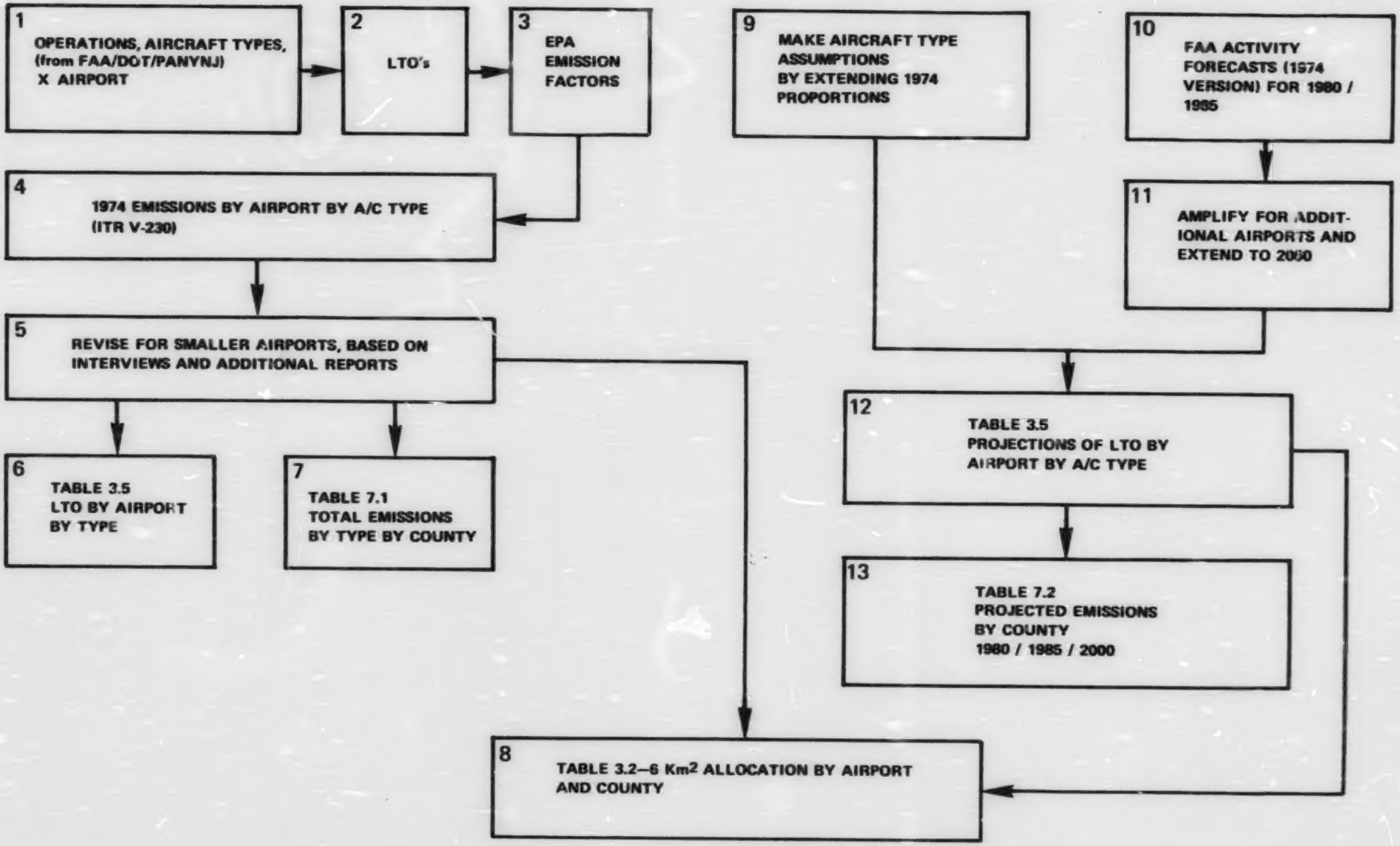
Highway vehicle emissions on roads within the larger airports will be calculated within the category of highway vehicle emissions (See Task A9a).

Step 1: Operations and Aircraft Types at Airports

Area. The airports selected in this work are those located in the Tri-State Region, except for Connecticut portion where only Fairfield County is included.

A8 AIRCRAFT
(AREA SOURCE)

LEVEL: 3
ORDER: PER MANUAL


1 OPERATIONS, AIRCRAFT TYPES, (from FAA/DOT/PANYNJ) X AIRPORT
2 LTO's
3 EPA EMISSION FACTORS
4 1974 EMISSIONS BY AIRPORT BY A/C TYPE (ITR V-230)
5 REVISE FOR SMALLER AIRPORTS, BASED ON INTERVIEWS AND ADDITIONAL REPORTS
6 TABLE 3.5 LTO BY AIRPORT BY TYPE
7 TABLE 7.1 TOTAL EMISSIONS BY TYPE BY COUNTY
8 TABLE 3.2–6 Km2 ALLOCATION BY AIRPORT AND COUNTY
9 MAKE AIRCRAFT TYPE ASSUMPTIONS BY EXTENDING 1974 PROPORTIONS
10 FAA ACTIVITY FORECASTS (1974 VERSION) FOR 1980 / 1985
11 AMPLIFY FOR ADDITIONAL AIRPORTS AND EXTEND TO 2000
12 TABLE 3.5 PROJECTIONS OF LTO BY AIRPORT BY A/C TYPE
13 TABLE 7.2 PROJECTED EMISSIONS BY COUNTY 1980 / 1985 / 2000

Airport Classification. The baseline (1974) information is available for 61 airports, one-third of which is named in the Tri-State Plan. The majority of the remaining 40 airports could be classified as non-tower General Aviation airports. Some of the private airports, heliports and seaplane bases are also included.

Aircraft Type. Since emission factors are given in pounds per engine per LTO cycle for each aircraft type, it was necessary to determine, for every airport, the percent distribution by type of aircraft and the number of engines. Aircrafts are categorized by type and number of engines in Appendix VI of TSRPC, Analysis Report V-230, Air Pollution Emissions from Aircraft, 1974, October 1975.

Traffic Activity. Information for major airports was extracted from DOT-FAA publication, FAA Air Traffic Activity, Calendar Year 1974, March 1975, and supplemented by a draft copy of a table prepared by NJ-DOT, 1974 Characteristics of New Jersey Airports.

Additional information for lesser airports was obtained from NYS-DOT sheets, Estimated Number of Aircraft Operations per Week: (1974).

Consultation of the airport management regarding volume and trends was used wherever available, especially at smaller non-plan airports.

Step 2

The methods used for establishing number of Landing and Take-off Cycles (LTO) for the base year are outlined in TSRPC Analysis Report V-230.

Step 3

Emission Factors. Emission factors for five pollutants are specified in "Compilation of Air Pollutant Emission Factors," Second Edition, issued by U.S. Environmental Protection Agency, April, 1973 (AP-42).

Steps 4-5

The methods used in calculating total yearly emissions are described in TSRPC Analysis Report V-230, previously mentioned.

While these emission factors remain constant, fluctuations of other components are so wide that a uniform methodology for the entire Region could not be developed.

Instead, every airport was analyzed separately and its emissions recorded in the appropriate forms. Details by individual airport are available in Tri-State's files.

Steps 8 and 14

Geographical Identification. A square-kilometer grid applied to "U.S.G.S. TOPOGRAPHIC MAP," 1951, photorevised 1972 ,and then updated through FAA Form 5010, was used for recording XY coordinates of the airports in question. These data were punched and the emissions from each airport distributed electronically.

Step 9

The distribution by type of aircraft fleet was developed in accordance with the following assumptions:

A rapid decline in Long Range Jet operations because of discontinued production (DC-8) and gradual replacement by the new wide-body type.

Gradual elimination of Air Carrier Turboprop types.

Progressive increase of General Aviation Turboprop operations, replacing a proportional number of comparable Piston Aircrafts.

Detailed assumptions for each airport are available in Tri-State's files.

Steps 10-11

All forecasts of key aviation activity at major Tri-State Plan airports for calendar years 1980, 1985 and 2000 were based on printouts made available for this project by the Aviation Forecast Branch of FAA. These sheets contain substantial revisions of statistics published by DOT-FAA in their preceding document, Terminal Area Forecast, 1976-1986, September 1974. One percent growth annually is anticipated between 1987 and 2000.

In some cases, particularly in New Jersey portion, the number of flights were projected in accordance with a table, Forecast of Annual Operations, developed by NJ-DOT.

General Aviation Forecasts

The only available publication on the subject, General Aviation Forecasts, 1975-1987 (Systems Consultants, Inc., April 1976) although sponsored by the DOT-FAA, does "not necessarily reflect the official views or policy of the Department of Transportation," as noted in the introduction.

This report, known also as FAA-AVP-76-7, provides annual forecasts and identifies the forecasting models and the rationale used in their development. These models, based on a state's wealth, population and aeronautical characteristics, were found acceptable. The statement on page 3 that "by 1987, the Northeast Region is expected to be the least active in terms of operations" is in agreement with the Tri-State assumptions.

According to Table 2.4-3.2 on page 27, the total number of G.A. operations in New York State in 1875 was 4,879,000 ops. In 1987, they will be 8,705,000 and the percentage of growth 1974-87 is shown on Figure 2.4-3 to be 84 percent; thus the estimated number of operations for 1974 is calculated as 8,705,000 ÷ 1.84 = 4,731,000 ops., and the growth factors from this baseline are:

1980 5,998,000 ÷ 4,731,000 = 1.2678

1985 7,792,000 ÷ 4,731,000 = 1.6470

2000 8,705,000 x 1.13 (one percent annual growth) =

9,836,700 ÷ 4,731,000 = 2.0792

The above forecasts are confirmed by several of the Region's airports, notably Zahn's, whose management anticipates the yearly rate of growth to be around 5 percent (26.78% ÷ 6 years = 4.96%).

The growth factor for 1985 may be slightly overestimated (64.7% ÷ 11 years = 5.9%) but the trend to the year 2000 appears more realistic (107.92% ÷ 26 years = 4.15%). These factors were considered valid for both New York and New Jersey.

Unless specifically rejected by a given airport staff, these factors were used throughout all counties of New York and New Jersey. Where FAA has made forecasts for specific airports, they were used (i.e., Teterboro, Newark).

(Step 11, continued)

Unimportant changes in the physical character of several airports during the period immediately following the base year were reflected in the 1980 forecasts. The nature of changes between the years 1980 and 2000 was found to be impossible of projection and therefore 1980 status was used in distributing emissions for 1985 and 2000.

Step 12

The calculations of LTO's for Table 3.5 reflect computations from basic work sheets, with one exception: For civil aviation types, projections were made separately for each subtype (number of engines), and then grouped into the categories required for Table 3.5.

A 9a MOBILE SOURCE EMISSIONS - HIGHWAY GASOLINE AND DIESEL

Level: Synthesized

Order: Expressway Mileage/Floor Area

METHOD

Refer to work chart for substance and sequence of steps. For those steps where procedures are not obvious, the following descriptions are provided. A chart from "Air Quality Plan/Transportation Plan Consistency Assessment.... TSRPC, July 1976" is included for additional detail.

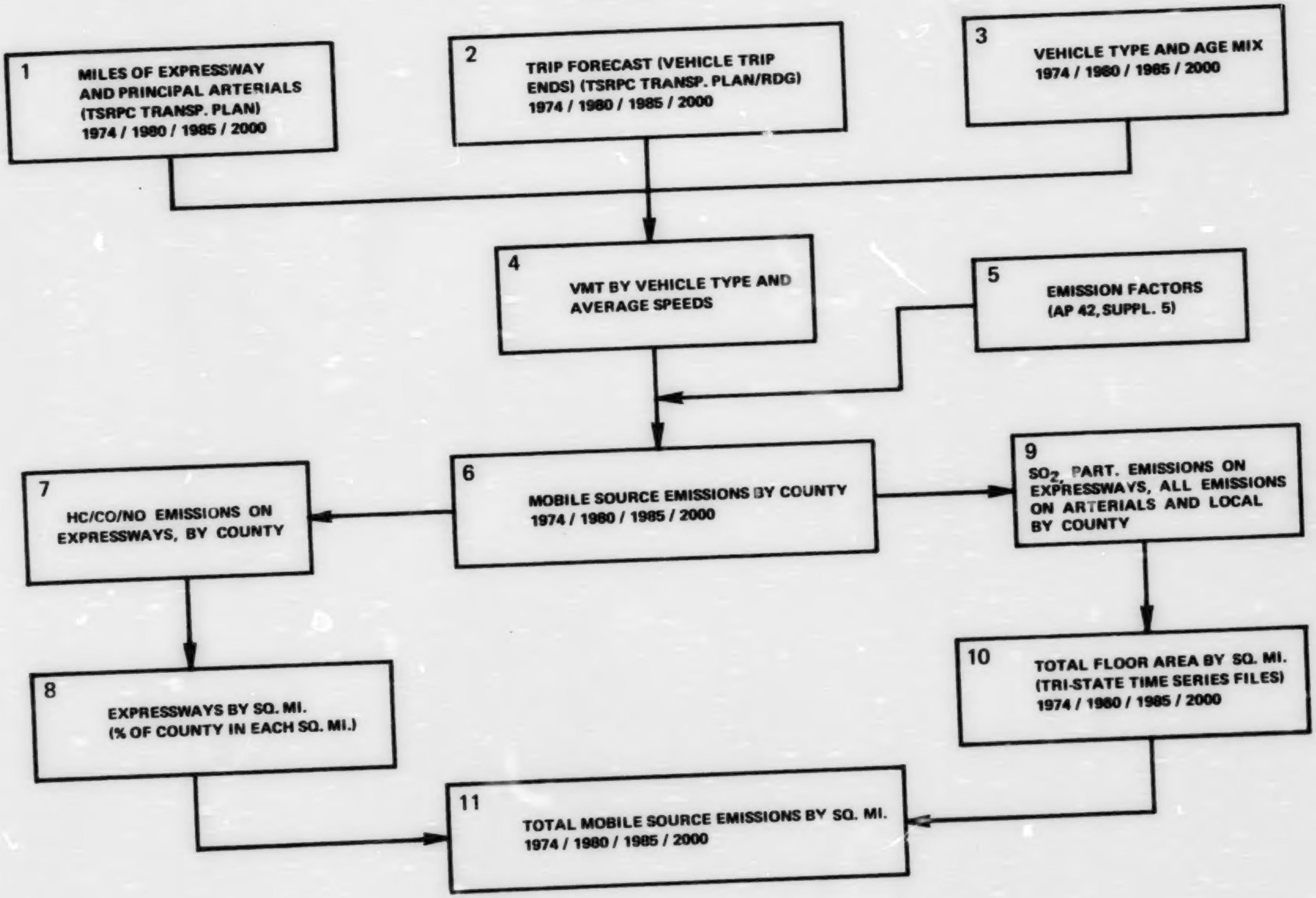
Step 1 Miles of Expressways and Arterials

The freeway and arterial supply, current and future, reflects the route miles and lane miles of expressways and principal arterials existing and programmed in the Tri-State transportation plan. Details are found in ITR 4572-1205, "Limited Access Highway Status Report: 1975," April 1976; and in Maintaining Mobility: The Plan and Program for Regional Transportation through 2000, 2d Edition, November 1976.

LEVEL: SYNTHESIZED
ORDER: EXPRESSWAY MILEAGE/FLOOR AREA

A9a MOBILE SOURCE EMISSIONS – GASOLINE AND DIESEL – HIGHWAY

(AREA SOURCE)


1
MILES OF EXPRESSWAY AND PRINCIPAL ARTERIALS (TSRPC TRANSP. PLAN) 1974 / 1980 / 1985 / 2000
2
TRIP FORECAST (VEHICLE TRIP ENDS) (TSRPC TRANSP. PLAN/RDG) 1974 / 1980 / 1985 / 2000
3
VEHICLE TYPE AND AGE MIX 1974 / 1980 / 1985 / 2000
4
VMT BY VEHICLE TYPE AND AVERAGE SPEEDS
5
EMISSION FACTORS (AP 42, SUPPL. 5)
6
MOBILE SOURCE EMISSIONS BY COUNTY 1974 / 1980 / 1985 / 2000
7
HC/CO/NO EMISSIONS ON EXPRESSWAYS, BY COUNTY
8
EXPRESSWAYS BY SQ. MI. (% OF COUNTY IN EACH SQ. MI.)
9
SO2, PART. EMISSIONS ON EXPRESSWAYS, ALL EMISSIONS ON ARTERIALS AND LOCAL BY COUNTY
10
TOTAL FLOOR AREA BY SQ. MI. (TRI-STATE TIME SERIES FILES) 1974 / 1980 / 1985 / 2000
11
TOTAL MOBILE SOURCE EMISSIONS BY SQ. MI. 1974 / 1980 / 1985 / 2000

Step 2 Trip Forecast

Estimating travel demand, in terms of vehicle trip ends (VTE), involves forecasting county vehicle registrations based on estimates of income, density, and household characteristics. Trip rates per registered vehicle are then applied to produce vehicle trips, which are allocated to square miles based on estimates of households and nonresidential activity. (ITR 1507 and 1508: "Highway Travel Forecasts 1980 Through 2000." March 1977).

Step 3 Vehicle Type and Age

Vehicle age distribution by type is taken from Supplement No.6, USEPA, December 1975.

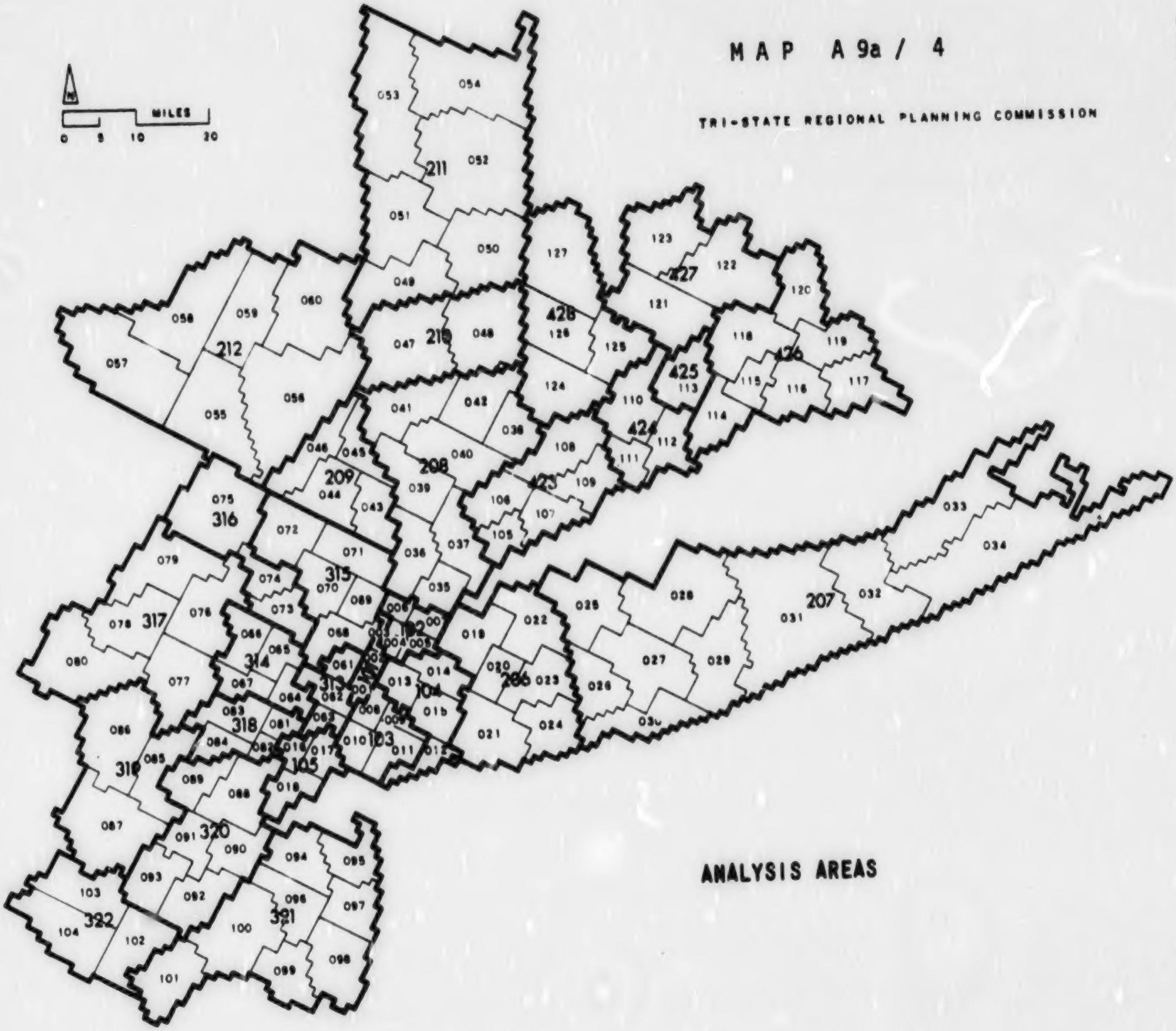
Step 4 VMT By Vehicle Type and Average Speeds

The vehicle miles of travel and speeds are projected for each of the Analysis Areas (see Map 9a/4) using the Highway Evaluation Model (HEM). This model is described in detail in ITR 4432-2101, "Cost and Performance Evaluation of Alternate Highway Strategies" and ITR 4212-2461, "Evaluating the Interim Plan II."

The Highway Evaluation Model is not a network model. VMT and speeds are estimated independently for each Analysis Area based upon input vehicle trip ends (VTE) and roadway supply. The model was calibrated based on observed 1963 travel patterns and reflects shorter average trip lengths (VMT/VTE) at higher densities and increased travel as a result of added freeway supply.

MAP A9a / 4

TRI-STATE REGIONAL PLANNING COMMISSION


N
MILES
0
5
10
20
053
054
211
052
051
050
049
127
123
427
122
121
120
058
059
060
212
057
055
056
047
210
048
428
126
125
124
118
426
119
425
113
115
116
117
114
041
042
038
040
110
424
112
111
046
045
209
044
043
208
039
108
423
109
106
107
105
075
316
072
071
036
037
033
034
079
315
070
069
074
073
035
025
028
207
032
031
078
317
076
006
102
007
019
022
066
065
314
004
005
080
077
067
064
061
313
013
014
020
206
023
027
029
026
062
104
015
083
318
081
063
006
010
103
011
012
021
024
030
086
084
082
016
017
319
085
105
089
088
018
087
091
320
090
094
095
093
092
096
097
103
322
104
102
100
321
098
099
101

ANALYSIS AREAS

Step 5 Emission Factors

The emissions are estimated using a computer program supplied by the New York City Department of Air Resources based on the method described in Supplement No.5.

SO_x and Particulates: The emission rates (gms/veh.mi.) for each vehicle type were extracted from the following tables in Supplement 5.

Light-duty vehicles	Table 3.1.2-13
Light-duty gas trucks	Table 3.1.4-7
Heavy-duty gas trucks	Table 3.1.4-13
Heavy-duty diesel vehicles	Table 3.1.5-1

HC, CO, and NO_x: The emission rates were obtained by use of Supplement 5 methodology, with inputs as follows:

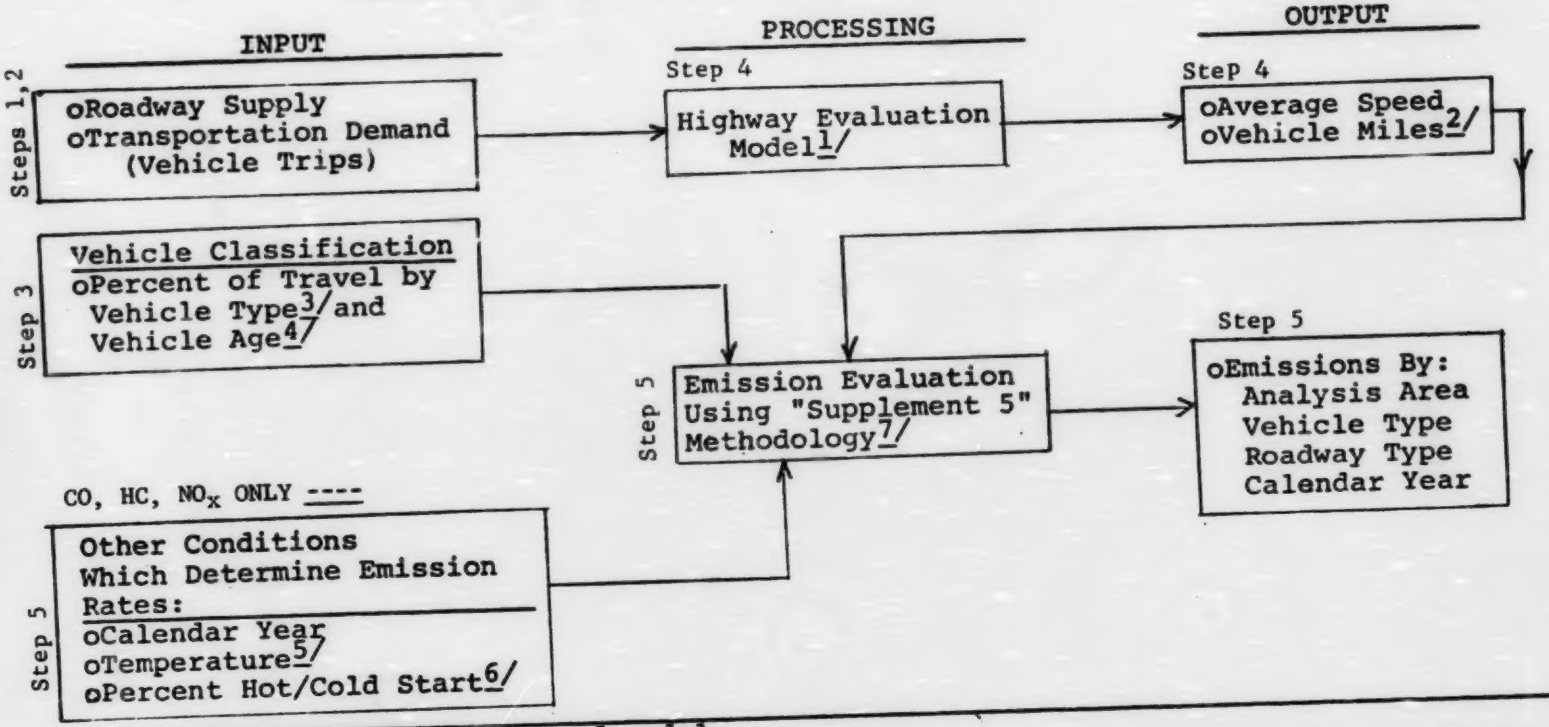
Vehicle speeds (from HEM)
Percent Hot Plus Cold Operation
Calendar Year
Temperature: annual average
Proportion of Vehicle Miles by Type
Age mix of vehicles from Supplement 5
Proportion of Starts which are Cold

Step 6 Expressway/Arterial-Local Split

The Highway Evaluation Model with the emissions subroutine provides the HC, CO, and NO pollutants emitted by motor vehicles on expressways, arterial streets, and local streets. Pollutants emitted on expressways are allocated to km^2 based on the proportion of miles of expressway in each km^2. All pollutants emitted on arterials and local roads are distributed to km^2 based on the proportion of total floor area in each km^2.

(From: "Air Quality Plan/Transportation Plan Consistency Assessment" TSRPC, July 1976.)

MOBILE SOURCE EMISSIONS PROJECTION OUTLINE


INPUT
PROCESSING
OUTPUT
Steps 1,2
oRoadway Supply
oTransportation Demand
(Vehicle Trips)
Step 4
Highway Evaluation Model1/
Step 4
oAverage Speed
oVehicle Miles2/
Step 3
Vehicle Classification
oPercent of Travel by Vehicle Type3/ and Vehicle Age4/
Step 5
Emission Evaluation Using "Supplement 5" Methodology7/
Step 5
oEmissions By:
Analysis Area
Vehicle Type
Roadway Type
Calendar Year
CO, HC, NOx ONLY ----
Step 5
Other Conditions Which Determine Emission Rates:
oCalendar Year
oTemperature5/
oPercent Hot/Cold Start6/

1/ See text for description of model.

2/ Speeds and Vehicle Miles of Travel are calculated for each of 126 Analysis Areas within the Region for freeway, arterial, and local streets.

3/ See Table A-1 for percent of travel by vehicle type by county.

4/ See Table A-2 for percent of travel by vehicle age for each vehicle type.

5/ Worst Case conditions are evaluated by assuming 32 Deg.F. for CO and 74 Deg.F for HC and NO_x and then averaging for each pollutant, as instructed by EPA Region II.

6/ The EPA defines the hot or cold start condition to occur for 505 seconds after the start of a vehicle. The total hot plus cold start vehicle hours is: 505 (seconds per start) X VTE (Vehicle trips)/3600 (seconds per hour). This number of hours is split up between the expressway arterial, and local street in such a way that a higher proportion is assigned to local and arterial street. The starts are then divided between hot and cold based on observed data by County and vehicle type (see Table A-3).

7/ This program was supplied by the New York City Dept. of Air Resources Method described in "Supplement No. 5 for Compilation of Air Pollutant Factors", USEPA.

A 9b (i) OFF-HIGHWAY FUEL USE - GASOLINE

Level: generally 3 (p.91 of Guidelines, Vol.7)
Order: population base (no number given)

The work chart gives substance and sequence of steps. The following explanations give details for those steps where method is not obvious.

Off-highway gasoline use is divided into two categories: tractors and all other agricultural and small utility equipment.

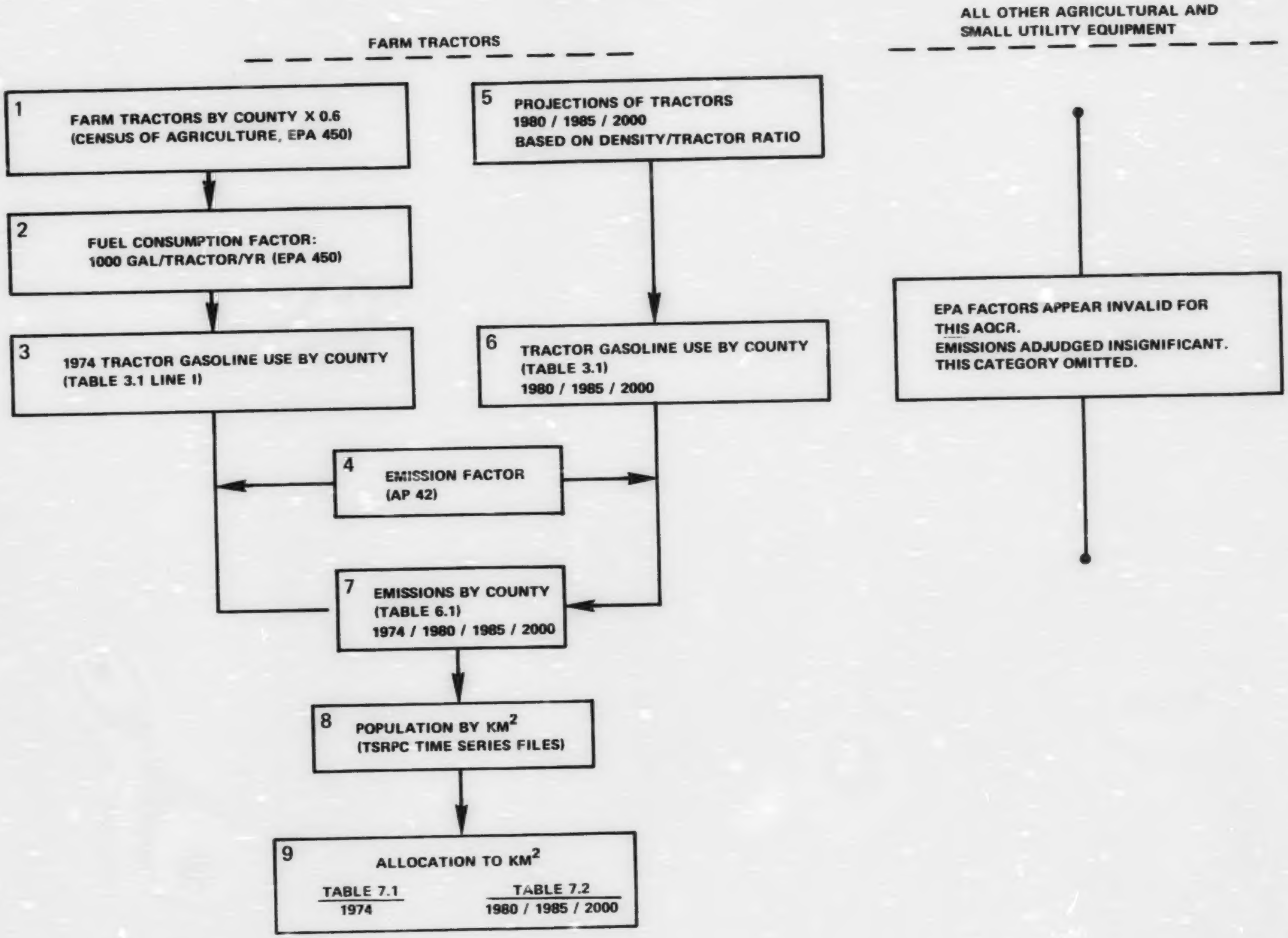
Step 1

County tractor data was obtained from the 1950, 1960, and 1970 Census of Agriculture. These data and corresponding U.S. Census population density data by counties were used to develop an historical relationship of tractor per capita to population density. As county population density increases, tractors per capita decrease sharply. Variables are related in a logarithmic scale such that as population density increases and tractors per capita decrease, tractors per square mile also decrease. This relationship and Tri-State

A9b (i) OFF HIGHWAY FUEL USE–GASOLINE

(MISC. AREA SOURCE)

LEVEL: 3
ORDER: POPULATION


FARM TRACTORS
ALL OTHER AGRICULTURAL AND SMALL UTILITY EQUIPMENT
1 FARM TRACTORS BY COUNTY X 0.6 (CENSUS OF AGRICULTURE, EPA 450)
2 FUEL CONSUMPTION FACTOR: 1000 GAL/TRACTOR/YR (EPA 450)
3 1974 TRACTOR GASOLINE USE BY COUNTY (TABLE 3.1 LINE I)
4 EMISSION FACTOR (AP 42)
5 PROJECTIONS OF TRACTORS 1980 / 1985 / 2000 BASED ON DENSITY/TRACTOR RATIO
6 TRACTOR GASOLINE USE BY COUNTY (TABLE 3.1) 1980 / 1985 / 2000
7 EMISSIONS BY COUNTY (TABLE 6.1) 1974 / 1980 / 1985 / 2000
8 POPULATION BY KM^2 (TSRPC TIME SERIES FILES)
9 ALLOCATION TO KM^2
TABLE 7.1 1974
TABLE 7.2 1980 / 1985 / 2000
EPA FACTORS APPEAR INVALID FOR THIS AQCR.
EMISSIONS ADJUDGED INSIGNIFICANT.
THIS CATEGORY OMITTED.

Regional Planning Commission (TSRPC) population density data were then used to calculate 1974 tractors by county. Gasoline tractors were assumed to constitute 60% of all tractors (from EPA-450).

Step 2

Each gasoline tractor was estimated to consume an average of 1000 gallons/year. (This figure is given in EPA-450 and is presumably a national average.)

Step 4

Emission factors given in AP-42 were then applied to fuel used to calculate emissions.

Steps 5-6

The method for projecting future year emissions was analogous to the base year approach with the following addition: Future county tractor populations were projected using TSRPC population density forecasts and the same historical tractor per capita/population density relationship used for base-year calculations.

Other off-highway gasoline uses such as lawn mowers, chain saws, snowmobiles, and agricultural equipment other than tractors.

The EPA-450 manual provides a national average use factor of 13 gallons/

person for these types of off-highway gasoline uses. However, most of this was assumed to relate to agricultural equipment other than tractors. For this Region it is reasonable to assume that these types of gasoline use are negligible, since nearly all agricultural equipment is tractor driven. Gasoline powered chain saws, snowmobiles, and gasoline powered lawn mowers are not assumed to yield emissions for base and future years. The Emission Factors Section (MD-14), National Air Data Branch, U.S. Environmental Protection Agency, Research Triangle Park, North Carolina 27711, was consulted on this subject and generally concurs with the Tri-State approach.

A 9b (ii) OFF-HIGHWAY FUEL USE--DIESEL

Level: 3 (p.92, Guidelines, Vol.7)

Order: by population (number not given)

Off-highway diesel fuel use is divided for estimation purposes into farm tractors, other farm equipment, and construction equipment. The flow chart gives the substance and sequence of steps. The following explanations are provided for those steps where detailed information is necessary.

Step 1

The procedure for estimating overall 1974 tractors by county is described under A 9b(i), step 1,Off-Highway Gasoline. Diesel tractors are assumed to constitute 35% of all tractors.

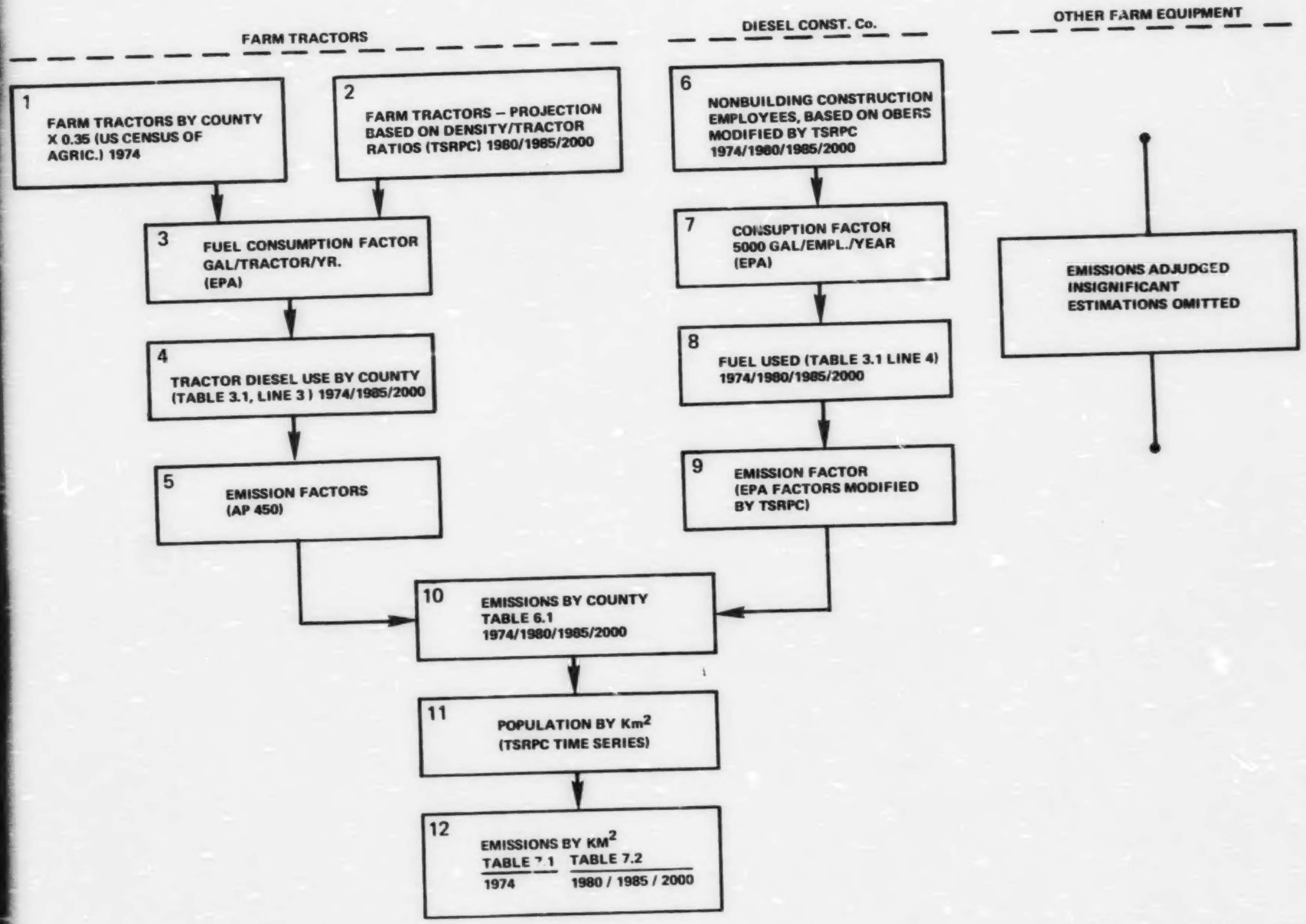
Step 2

The procedure for projecting future emissions is similar except with regard to estimation of tractor populations (described under A 9b(i), step 6.)

A9b (ii) OFF HIGHWAY FUEL USE–DIESEL

(MISC. AREA SOURCE)

LEVEL: 2
ORDER: POPULATION


FARM TRACTORS
DIESEL CONST. Co.
OTHER FARM EQUIPMENT
1 FARM TRACTORS BY COUNTY X 0.35 (US CENSUS OF AGRIC.) 1974
2 FARM TRACTORS – PROJECTION BASED ON DENSITY/TRACTOR RATIOS (TSRPC) 1980/1985/2000
3 FUEL CONSUMPTION FACTOR GAL/TRACTOR/YR. (EPA)
4 TRACTOR DIESEL USE BY COUNTY (TABLE 3.1, LINE 3) 1974/1985/2000
5 EMISSION FACTORS (AP 450)
6 NONBUILDING CONSTRUCTION EMPLOYEES, BASED ON OBERS MODIFIED BY TSRPC 1974/1980/1985/2000
7 CONSUPTION FACTOR 5000 GAL/EMPL./YEAR (EPA)
8 FUEL USED (TABLE 3.1 LINE 4) 1974/1980/1985/2000
9 EMISSION FACTOR (EPA FACTORS MODIFIED BY TSRPC)
EMISSIONS ADJUDGED INSIGNIFICANT ESTIMATIONS OMITTED
10 EMISSIONS BY COUNTY TABLE 6.1 1974/1980/1985/2000
11 POPULATION BY Km²
(TSRPC TIME SERIES)
12 EMISSIONS BY KM²
TABLE 7.1 1974
TABLE 7.2 1980 / 1985 / 2000

Step 3

Each tractor is estimated to consume an average of 1000 gallons/year. (These figures are given in EPA-450 and are presumably national averages.)

Step 6

County non-building construction employee data for 1973 was obtained from "County Business Patterns." The term "non-building construction" is assumed to include the following construction categories: heavy construction, concrete, structural steel, excavating and foundation, and wrecking and demolition. A survey of employment in the Tri-State Region between 1958 and 1970 (TSRPC Interim Technical Report 4287-2501) shows that the percentage share attributable to the construction industry has remained stable (3-4%) over this period; construction employment has grown over the years in approximately the same proportion as total employment. If one assumes this to continue to hold for future years, 1974 non-building construction employees is then computed from the product of the 1973 numbers and the 1973-4 growth factor derived from total employment.

Non-building construction employees are forecasted by applying growth factors. These were obtained by dividing TSRPC forecasts of employment for future years by the 1973 levels.

Step 7

Construction equipment is estimated to consume 5000 gallons/year/non-building construction employee. (This figure is provided in EPA-450 and is presumably a national average.)

Step 9

Factors listed under the miscellaneous construction equipment category are used to approximate average values for all types of equipment.

Other Diesel Equipment

The EPA-450 book provides a national average use factor of 7.5 gallons/person for these types of off-highway diesel uses. However, for this Region it is reasonable to assume that these types of diesel uses are negligible; nearly all agricultural equipment in the Region is tractor driven and other possible uses are insignificant for base and target years.

The Emission Factors Section (MD-14), National Air Data Branch, U.S. Environmental Protection Agency, Research Triangle Park, was consulted on this subject and generally concurs with the Tri-State approach.

A 10 SOLVENTS

Level: generally 2 (p.76 of Guidelines, vol.7)

Order: by population, number not given

The work chart gives substance and sequence of steps. The following will supply details for steps where procedures are not obvious.

Step 1

Solvents used in each county are estimated from county populations and the following national average use factors provided in EPA-450:

a) County population less than 100,000--3 lbs/capita/yr

b) County population 100,000 to 500,000--8 lbs/capita/yr

c) County population 500,000 to 1,000,000--18 lbs/capita/yr

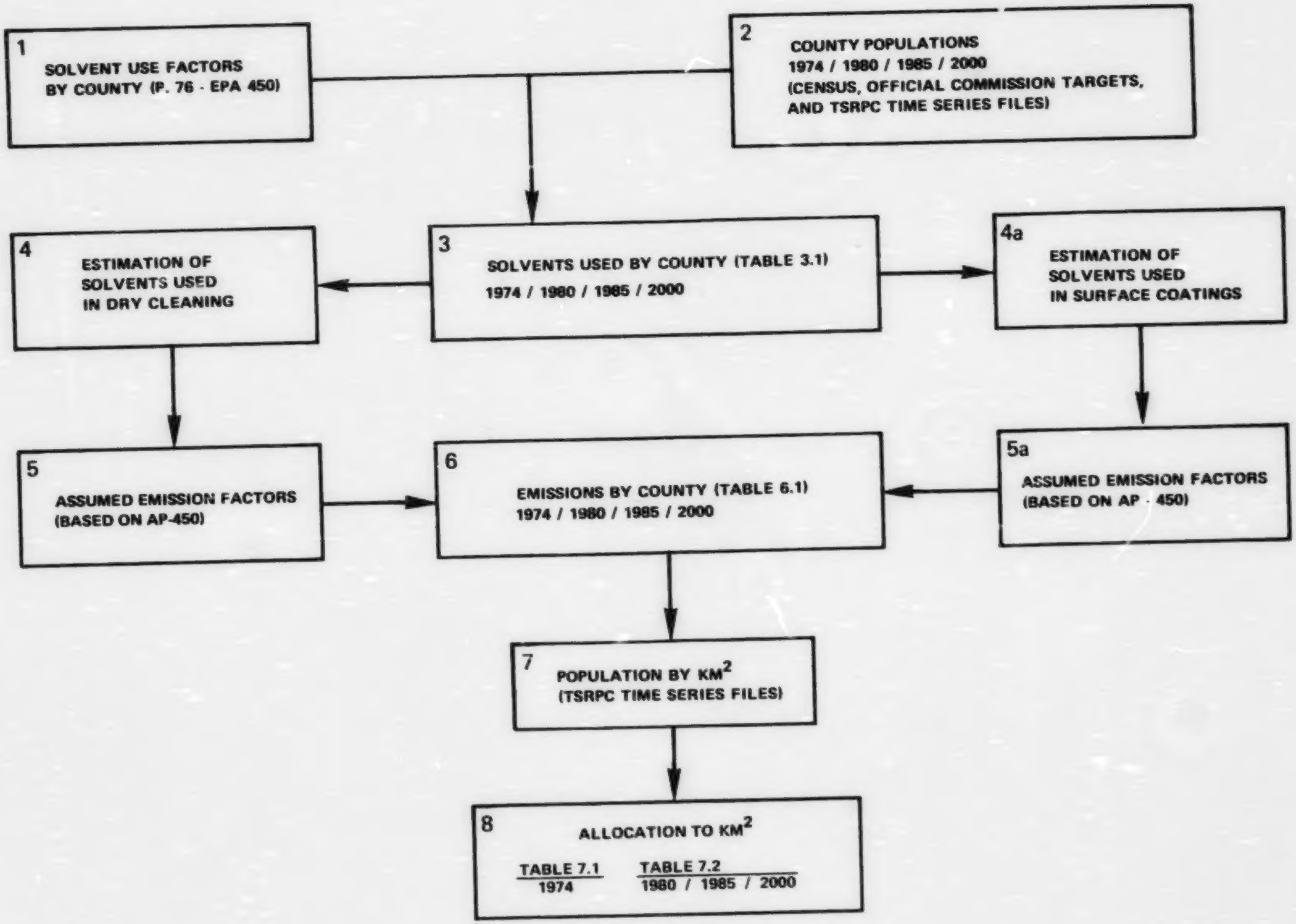
d) County population greater than 1,000,000--28 lbs/capita/yr

The above factors include solvents used for dry cleaning and in surface coatings.

A10 EVAPORATION–SOLVENTS

(MISC. AREA SOURCE)

LEVEL: 2
ORDER: POPULATION


1
SOLVENT USE FACTORS BY COUNTY (P. 76 - EPA 450)
2
COUNTY POPULATIONS 1974 / 1980 / 1985 / 2000 (CENSUS, OFFICIAL COMMISSION TARGETS, AND TSRPC TIME SERIES FILES)
4
ESTIMATION OF SOLVENTS USED IN DRY CLEANING
3
SOLVENTS USED BY COUNTY (TABLE 3.1) 1974 / 1980 / 1985 / 2000
4a
ESTIMATION OF SOLVENTS USED IN SURFACE COATINGS
5
ASSUMED EMISSION FACTORS (BASED ON AP-450)
6
EMISSIONS BY COUNTY (TABLE 6.1) 1974 / 1980 / 1985 / 2000
5a
ASSUMED EMISSION FACTORS (BASED ON AP - 450)
7
POPULATION BY KM^2 (TSRPC TIME SERIES FILES)
8
ALLOCATION TO KM^2
TABLE 7.1 / 1974
TABLE 7.2 / 1980 / 1985 / 2000

Steps 4 and 5

Emission factors are provided in AP-42 only for specific dry cleaning and surface coating applications. It is therefore necessary to estimate the proportion of solvent associated with each type of application.

Approximately 2.35 lbs of solvent per person are used on the average for dry cleaning in the United States (given in AP-42). The 1975 population of the United States according to "Statistical Abstracts" is 213,000,000. This translates into 500,550,000 lbs of solvent used in dry cleaning for the country in 1975. According to the National Paint and Surface Coating Manufacturers Association, 889,567,000 gallons of surface coating were sold in the country in 1975. If we assume an average that one gallon of surface coating weighs approximately 12.5 lbs (given in AP-42), the amount of surface coating sold then translates into 1,111,958,000 lbs. However, only approximately 60% of surface coating by weight is solvent. Therefore, the amount of solvent used in surface coatings in the nation in 1975 was approximately only 667,175,000 lbs. Total solvent use in the nation for 1975 is the amount used in dry cleaning, 500,550,000 lbs, plus the amount used in surface coatings, 667,175,000 lbs, equals 1,167,725,000 lbs: approximately 43% used in dry cleaning, 57% in surface coatings.

If one assumes average conditions for the dry cleaning industry as stated in AP-42, (50% of all dry cleaning solvents are petroleum based, the other 50% synthetically based; no petroleum solvent plants are controlled and only 25% of all synthetic solvent plants are controlled) county dry cleaning solvents are then easily applied to emission factors given in AP-42.

In order to apply surface coating emission factors, county surface coating solvents must be first translated back into total surface coating weight and then must be broken down into the various types of surface coating. According to the Sherwin Williams Co., one of the nation's leading surface coating manufacturers, the following is the approximate breakdown of their sales by weight of various surface coatings:

50%	paint
10%	lacquers
5%	varnish
20%	enamels
15%	primers

Emission factors provided in AP-42 could then be applied.

FUTURE YEAR APPROACHES

Step 6

Future county solvent use quantities are obtained by applying the same county solvent use factors to the TSRPC population forecasts.

A 10 a EVAPORATION - GASOLINE MARKETING

Level: generally 2 (p.76, Guidelines, Vol.7)
Order: Population base (no number given)

The work chart gives substance and sequence of steps. The following will supply details for steps where procedures are not obvious.

Step 1

The methods used to estimate these quantities are an element in Tri-State's transportation planning process. Details are given in TSRPC Interim Technical Report 4506-1205: Gasoline Consumption: 1967 and 1972, April 1975.

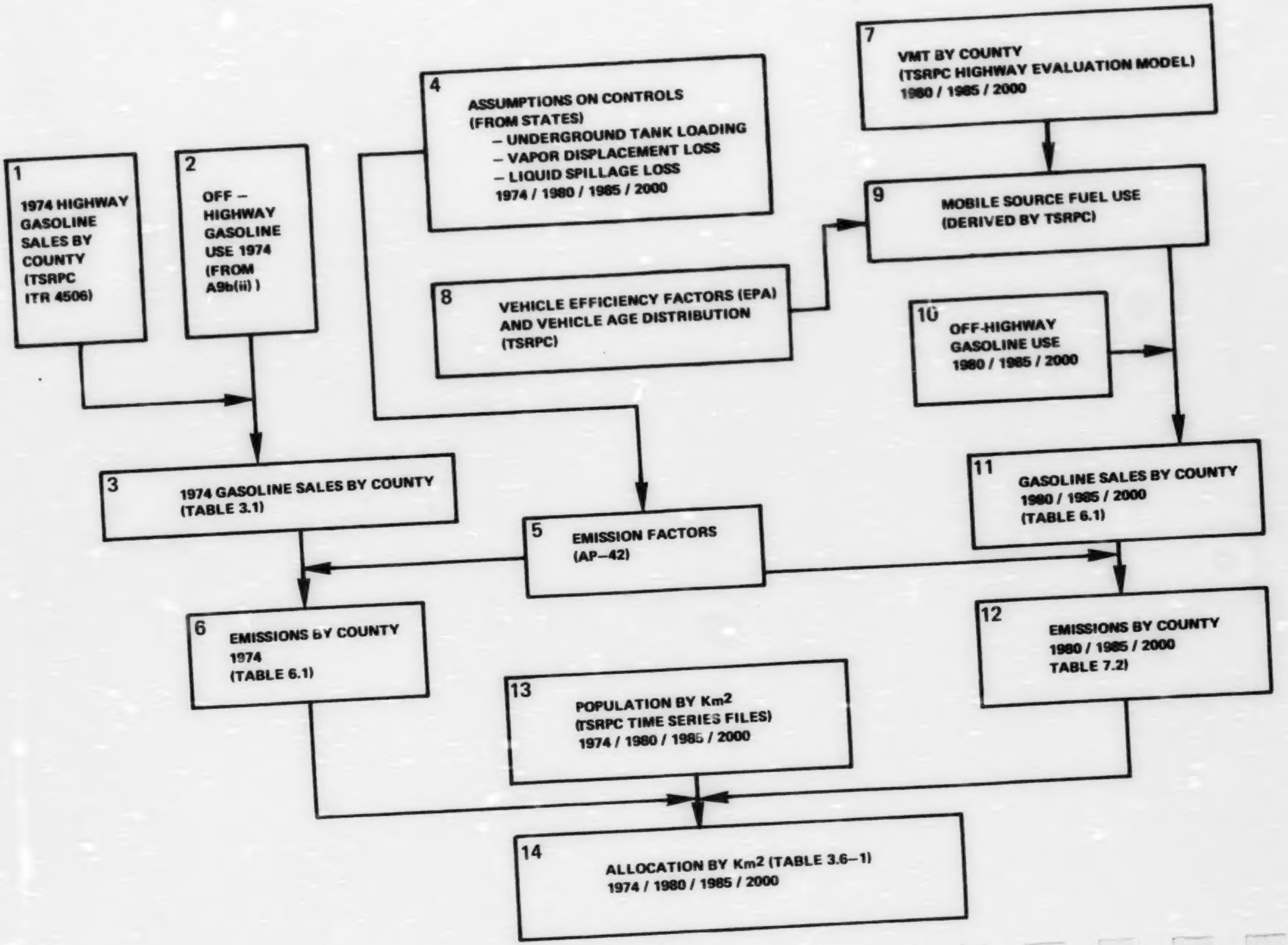
Steps 2 and 3

Totals from Step 1 plus off-highway gasoline use calculated in A9b(ii) equals total 1974 gasoline sales.

A10a EVAPORATION - GASOLINE MARKETING

(MISC. AREA SOURCE)

LEVEL 1 / 2 / 3


1 1974 HIGHWAY GASOLINE SALES BY COUNTY (TSRPC ITR 4506)
2 OFF – HIGHWAY GASOLINE USE 1974 (FROM A9b(ii))
3 1974 GASOLINE SALES BY COUNTY (TABLE 3.1)
4 ASSUMPTIONS ON CONTROLS (FROM STATES) – UNDERGROUND TANK LOADING – VAPOR DISPLACEMENT LOSS – LIQUID SPILLAGE LOSS 1974 / 1980 / 1985 / 2000
5 EMISSION FACTORS (AP–42)
6 EMISSIONS BY COUNTY 1974 (TABLE 6.1)
7 VMT BY COUNTY (TSRPC HIGHWAY EVALUATION MODEL) 1980 / 1985 / 2000
8 VEHICLE EFFICIENCY FACTORS (EPA) AND VEHICLE AGE DISTRIBUTION (TSRPC)
9 MOBILE SOURCE FUEL USE (DERIVED BY TSRPC)
10 OFF-HIGHWAY GASOLINE USE 1980 / 1985 / 2000
11 GASOLINE SALES BY COUNTY 1980 / 1985 / 2000 (TABLE 6.1)
12 EMISSIONS BY COUNTY 1980 / 1985 / 2000 TABLE 7.2)
13 POPULATION BY Km2 (TSRPC TIME SERIES FILES) 1974 / 1980 / 1985 / 2000
14 ALLOCATION BY Km2 (TABLE 3.6–1) 1974 / 1980 / 1985 / 2000

Step 4

The following assumptions were obtained from the respective states relating to the marketing of gasoline.

a) loading of underground gasoline storage tanks--

N.Y. - all splash fill, 1974, 1980, 1985, 2000.

N.J. - all splash fill, 1974; submerged fill with open vapor, 1980, 1985, 2000.

Conn - 50% splash fill, 50% submerged uncontrolled fill, 1974; reduction of 80% of emissions over what would occur from submerged uncontrolled fill, 1980, 1985, 2000. (Stage 1 regulation stated for May 31, 1977.)

b) filling of motor vehicles: 1) vapor displacement loss and 2) liquid spillage loss--

N.Y. - no controls, 1974, 1980, 1985, 2000.

N.J. - no controls, 1974, 1980, 1985, 2000.

Conn - no controls, 1974, 1980; 80% reduction of both vapor displacement and liquid spillage loss, 1985, 2000. (Stage II. regulation tentatively slated for May 31, 1980. Additional public hearings may be required before that time for final approval.)

Assumptions used by states were obtained from the following sources:

N.Y. Department of Environmental Conservation - Jack Lauber,
Bureau of Source Control, Proce[illegible]ction, 518-457-5309

N.J. Department of Environmental Protection - Larry Gorry
609-292-5450

Connecticut Department of Environmental Protection - Jim Vicary,
Enforcement Section, 203-566-3160

Step 7

From Tri-State's Highway Evaluation model. This is an element in Tri-State's transportation planning process. See A9a - Highway Gasoline/Diesel for explanation.

Step 8

Efficiency factors from EPA regulations for automotive manufacture, P.L. 94-163, TITLE V., Vehicle age distribution from Highway Evaluation model (Step 7).

Step 10

Calculated in A9b(ii).

A 11 FUGITIVE DUST - APARTMENT CONSTRUCTION

Level: Not in Guidelines

Order: Housing-based Distribution

EPA studies provide emission rates for only two kinds of construction - apartment houses and shopping centers. In response, a valid method for estimating apartment house construction and land involved was developed. In addition, considerable research was done to project the proportion of commercial activity in shopping centers so that this aspect could also be estimated. However, the lack of any reliable method for locating future shopping center construction aborted this effort. Commercial zoning is not usually done for shopping centers; rather, zoning for such large development would be a response to developer's specific requests. Thus, zoning could not be justified as a locator.

The following gives details for those steps that are not obvious on the work chart.

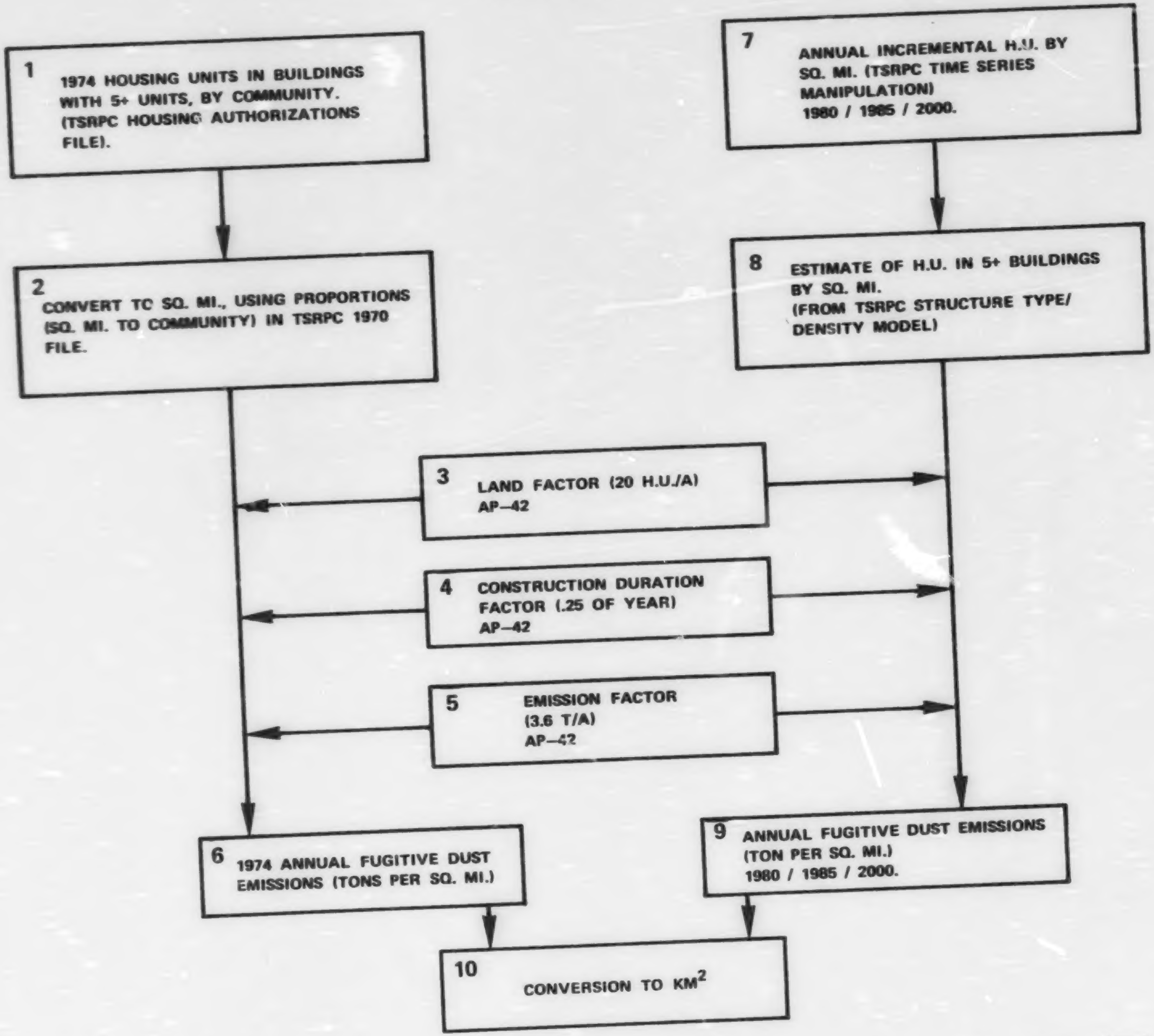
Step 1 1974 Housing Units

Tri-State routinely monitors housing authorizations by community, using the structure-size breaks provided in reports.

LEVEL: NOT GIVEN
ORDER: BASED ON HOUSING/TYPE DISTRIBUTION

A11 FUGITIVE DUST – APARTMENT CONSTRUCTION

(AREA SOURCE)


1 1974 HOUSING UNITS IN BUILDINGS WITH 5+ UNITS, BY COMMUNITY. (TSRPC HOUSING AUTHORIZATIONS FILE).
2 CONVERT TO SQ. MI., USING PROPORTIONS (SQ. MI. TO COMMUNITY) IN TSRPC 1970 FILE.
7 ANNUAL INCREMENTAL H.U. BY SQ. MI. (TSRPC TIME SERIES MANIPULATION) 1980 / 1985 / 2000.
8 ESTIMATE OF H.U. IN 5+ BUILDINGS BY SQ. MI. (FROM TSRPC STRUCTURE TYPE/ DENSITY MODEL)
3 LAND FACTOR (20 H.U./A) AP–42
4 CONSTRUCTION DURATION FACTOR (.25 OF YEAR) AP–42
5 EMISSION FACTOR (3.6 T/A) AP–42
6 1974 ANNUAL FUGITIVE DUST EMISSIONS (TONS PER SQ. MI.)
9 ANNUAL FUGITIVE DUST EMISSIONS (TON PER SQ. MI.) 1980 / 1985 / 2000.
10 CONVERSION TO KM²

Steps 3, 4, and 5

The land where apartment construction occurs in the base year and each of the target years was calculated at the rate of 20 d.u. per acre. The duration of dust-emitting construction was calculated at 0.25 of the year, thus giving a base for the application of the emission factor -- 3.6 tons per acre.

Step 7

The annual incremental growth in apartments was calculated from the TSRPC Time Series files, where housing unit totals and increments for five-year intervals to 2000 were available. This model is explained in ITR 4509: "Most Likely Targets for Planned Growth." January 1976. See also Appendix IV for a comprehensive treatment of housing inputs.

Step 8 Estimate of Apartment Units

The annual housing unit increments for the target years were distributed by structure type by using the Tri-State Structure Type/Density Model. Initial runs of the model were calibrated to documented changes between 1970 and 1975. A draft report explaining the workings of this model is available (Analysis Notes 3402).

Step 10

Emissions were initially allocated to square mile rather than km^2 since this was the more efficient method. The emissions were translated to the km^2 format at the same time as the land use parameters of the planning file, along with another type--vehicle emissions.

P 1 ELECTRIC GENERATING PLANTS

Update Level: 2/3 [pp. 75, 94, Guidelines, Vol. 8]
Projection Level: 2 [p. 131, Guidelines, Vol. 7]

Substance and sequence of steps are given in the work chart. The following details are provided for those where procedures are not obvious.

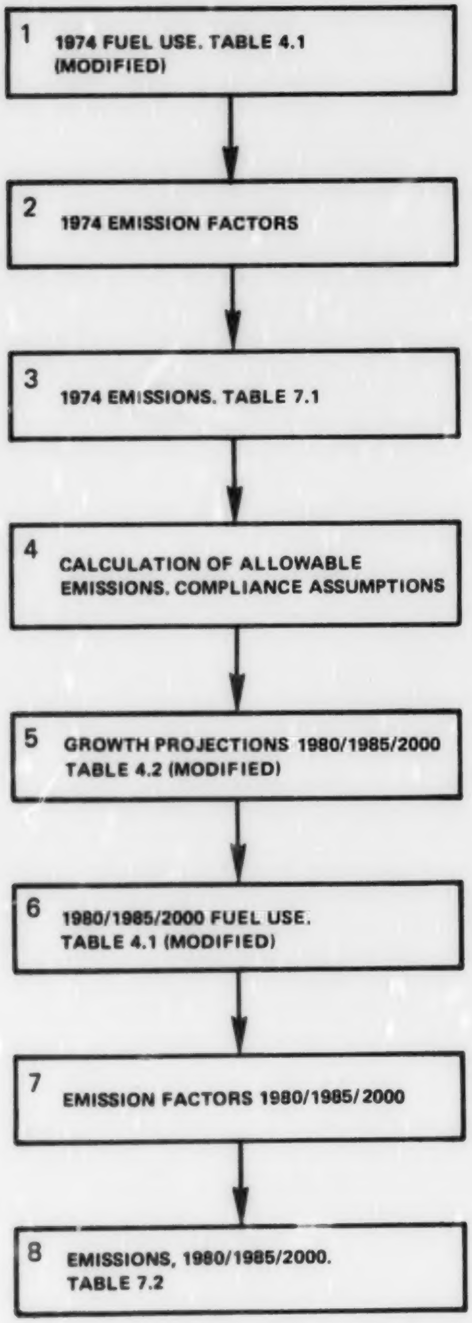
NEW JERSEY

Step 1

Fuel use data for facilities, and points within facilities, were derived from the following sources: The 1970 NEDS inventory, FPC Form 67, electric utility company 149-B reports, Steam-Electric Power Plant Factors, the 1975 NEDS inventory, and personal communications.

P1 ELECTRIC GENERATING PLANTS

LEVEL: 2/3


1 1974 FUEL USE. TABLE 4.1 (MODIFIED)
2 1974 EMISSION FACTORS
3 1974 EMISSIONS. TABLE 7.1
4 CALCULATION OF ALLOWABLE EMISSIONS. COMPLIANCE ASSUMPTIONS
5 GROWTH PROJECTIONS 1980/1985/2000 TABLE 4.2 (MODIFIED)
6 1980/1985/2000 FUEL USE. TABLE 4.1 (MODIFIED)
7 EMISSION FACTORS 1980/1985/2000
8 EMISSIONS, 1980/1985/2000. TABLE 7.2

New Jersey cont.

Step 2

EMISSION FACTORS FOR POWER PLANTS, EXTERNAL COMBUSTION

	FUEL			
	RESIDUAL OIL lb/10^3 gal		NATURAL GAS lb/10^6 cu.ft.	
Pollutant	1974	Forecast	1974	Forecast
Particulates	8.	6.	10.	10.
Sulfur Oxides	157.(s)	157.(s)	0.6	0.6
Nitrogen Oxides	105.	105,50*	600.	300,700*
Hydrobarbons	2.	1.	1.	1.
Carbon Monoxide	5.	17.	17.	17.

* From AP-42 (Table 1.4-1, 5/74-gas; Table 1.3-1, 4/76-oil: emissions from units installed after 1974, presumed to be tangentially fired, are calculated using the lower emission factors; emissions from older units are calculated using the higher factors.

EMISSION FACTORS FOR POWER PLANTS, INTERNAL COMBUSTION

	FUEL			
	DISTILLATE OIL lb/10^3 gal		NATURAL GAS lb/10^6 cu.ft.	
Pollutant	1974	Forecast	1974	Forecast
Particulates	5.	5.	14.	14.
Sulfur Oxides	144.(s)	3.5	0.6	0.6
Nitrogen Oxides	67.8	67.8	413.	413.
Hydrocarbons	5.57	5.57	42.	42.
Carbon Monoxide	15.0	15.4	115.	115.

Source: AP-42

New Jersey cont.

Step 4

Allowable emissions were calculated from the New Jersey Administrative Code Title 7, Chapter 27: Subchapter 4, Control and Prohibition of Solid Particles from Combustion of Fuel; and Subchapter 9, Sulfur in Fuels, Control Prohibition of Air Pollution from Sulfur Dioxide Caused by the Combustion of Fuel.

It was assumed that all sources which were not in compliance in 1974 would achieve compliance before 1980.

Step 5

Projections to Target Years 1980, 1985, and 2000

A. Facilities existing in 1974 were assumed to continue at the same rate of fuel consumption as in 1974 unless they were scheduled for retirement, in which case they were removed from the appropriate file or files.

B. In the case of steam boiler facilities whose fuel in 1974 was all or partially natural gas, the same proportional use of gas was assumed for 1980. For subsequent years, however, this was changed to all residual oil.

C. New generating facilities planned by the utilities were incorporated into the appropriate year file (and subsequently) according to estimated in-service dates.

D. Projected peak demand for each utility company in 1980, 1985, and 2000 was compared with projected capability to each time period. Estimates were made of required new facilities over and above announced plans of the

New Jersey Step 5 cont.

utilities, allowing for an 18 percent reserve over and above peak demand.

It was assumed that these unscheduled but needed units would be divided into fossil vs nuclear facilities in the same ratio as units for which the utilities had already announced plans.

In cases where the franchise area of a utility company extends beyond this AQCR, planned units without a specified location, and unscheduled units estimated to be required in the future, would be divided between in-Region and extra-Region location in the proportion that company's load in the Region bears to total load, as estimated by the utility companies.

Megawatt capacity of new fossil-fuel plants estimated to be built within the Region were allocated as equally as practicable among the company's existing fossil-fuel locations within the Region.

Unscheduled units inserted in the record are identified in the "Comments" section of the NEDS coding form as "hypothetical units."

A summary of reasoning by which fuel type and location allocations were made appears below for each electric utility serving the New Jersey sector of the AQCR.

New Jersey Step 5 cont.

Public Service Electric and Gas

1974 Capability - 8,541 Megawatts

Year	Peak Demand	Peak Plus 18% Reserve	Existing Plus Planned Capacity	Gap
1980	8,050	9,500	9,543	-
1985	9,850	16,620	12,680	3,940
2000	17,600	20,765	18,140	2,625

Of plans announced by the company, 4,750 MW or 84 percent are nuclear; 301 MW or 5 percent are fossil fueled, and 600 MW are unassigned. The last is assumed to be fossil fueled, under a conservative approach.

PSEG will have to add by 1985 3,940 MW of capacity over and above announced plans. Of this, it is assumed 16 percent will be fossil fueled--630 MW. The company estimates that 77 percent of its load is in the Region, so 77 percent of 630 MW (or 485 MW) of fossil capacity was assigned to the Region. This was split among the eight locations in the Region where company has fossil fuel facilities--60 MW of combustion turbines at each.

After 1985 another 2,625 MW of new capacity will be needed--16 percent (or 420 MW) of the fossil-fueled capacity, of which 77 percent (or 325 MW) will be within the Region. Additionally, the 600 MW of "unassigned" capacity planned by the company for 1987 and which is assumed will be fossil-fueled, will have to be assigned a location. The concern is with the 77 percent or 460 MW which will be located in the Region, making a total of 460 and 325 or 785 MW to locate. The solution was to locate 200 MW of conventional steam oil-fired capacity at each of four present locations randomly selected from the eight existing locations.

New Jersey Step 5 cont.

Jersey Central Power and Light

1974 Capability - 2,722 Megawatts

Year	Peak Demand	Peak Plus 18% Reserve	Existing Plus Planned Capacity	Gap
1980	3,116	3,675	3,065	609
1985	3,976	4,690	5,155	-
2000	8,226	9,705	5,155	4,553

Existing plans for additional capacity are 29 percent fossil, 71 percent nuclear. Additions are assumed to be in the same ratio.

JCPL will have to add 600 MW capacity by 1980, of which 180 MW will be fossil fueled. This was divided into four 45 MW turbines one assumed to be located at each of the company's four fossil-fuel locations. Of these, two are in the AQCR--at Sayreville and Werner.

Added between 1985 and 2000 will be 4,550 MW. It is assumed 30 percent or 1,360 MW will be oil-fueled conventional steam; one-half (680 MW) will be located at the Sayreville and Werner stations.

Step 7

The same emission factors as Step 2.

NEW YORK CITY

Step 1

Fuel use data for facilities, and points within facilities, were derived from the following sources: the 1970 NEDS inventory, FPC Form 67, electric utility company 149-B reports and personal communications, Steam-Electric Power Plant Factors, and the 1972 IPP inventory (obtained from the New York City Department of Air Resources).

Step 2

EMISSION FACTORS FOR POWER PLANTS, EXTERNAL COMBUSTION

	FUEL		
Pollutant	RESIDUAL OIL lb/10^3 gal	BITUMINOUS COAL lb/ton	NATURAL GAS lb/10^6 cu.ft.
Particulates	10(s) + 3	17.	10.
Sulfur Oxides	157(s)	38.(s)	0.6
Nitrogen Oxides	105,50*	18.	300,700*
Hydrocarbons	1	0.3	1.
Carbon Monoxide	5	1	17.

Source: AP-42

* From AP-42 (Table 1.4-1, 5/74-gas; Table 1.3-1, 4/76-oil): emissions from units installed after 1974, presumed to be tangentially fired, are calculated using the lower emission factors; emissions from older units are calculated using the higher factors.

New York City Step 2 cont.

EMISSION FACTORS FOR POWER PLANTS, INTERNAL COMBUSTION

	FUEL	
	DISTILLATE OIL	NATURAL GAS
Pollutant	$lb/10^3$ gal	$lb/10^3$ cu.ft.
Particulates	5.0	14.0
Sulfur Oxides	3.5	5.2
Nitrogen Oxides	67.8	413.0
Hydrocarbons	5.57	42.0
Carbon Monoxide	15.4	115.0

Source: AP-42

Step 4

Allowable emissions were calculated from the Administrative Code of the City of New York, Chapter 57, Emission Standards.

It was assumed that all sources which were not in compliance in 1974 would achieve compliance before 1980.

Step 5

Assumptions applicable to all sectors of the Region are reported on P 1/4 Jersey, Step 5. A summary of reasoning by which fuel type and location allocations were made appears below each electric utility serving the New York City and New York State sectors of the Region.

New York City Step 5 cont.

Consolidated Edison

1974 Capability - 10,359 Megawatts

Year	Peak Demand	Peak Plus 18% Reserve	Existing Plus Planned Capacity	Gap
1980	9,625	11,355	10,519	838
1985	10,890	12,850	11,519	1,341
2000	16,810	19,835	12,519	7,316

By 1985, the Power Authority of State of New York (PASNY) is scheduled to take over Con Ed's MTA load, with estimated peaks of 1,036 MW in 1985 and 2,291 MW in 2000. Failing this take-over, Con Ed's peaks would be higher by these amounts. Indian Point #3 (nuclear) and Astoria #6 (oil fueled),scheduled for completion in 1976, are to be taken over by PASNY.

The only planned additions to Con Ed's capacity are an uprating of Indian Point #2 of 160 MW in 1980; and for the Cornwall pumped storage facility, 1000 MW in 1985 and 1,000 MW in 1986.

However, nuclear units planned by the New York Power Pool for the late 1980's and 1990, totalling 9,100 MW, and a coal plant @ 850 MW have not been identified as to specific ownership; and except for 2,600 MW at Shoreham, locations have not been announced.

The projected coal-burning plant is to be called Lake Erie #2. Lake Erie #1 is planned by Niagara Mohawk, so #2 is unlikely to be in this AQCR.

It is assumed that Con Ed requirements will be met by fossil plants outside the Region and by nuclear plants.

New York City Step 5 cont.

Central Hudson Gas and Electric

1974 Capability - 787 Megawatts

Year	Peak Demand	Peak Plus 18% Reserve	Existing Plus Planned Capacity	Gap
1980	985	1,160	787	375
1985	1,435	1,690	1,456	235
2000	2,680	3,160	1,690	1,470

Existing plans --			
	9% of Nine Mile Pt #2 (N)	99 MW	1981
	17% of Sterling (N)	195	1982

Of the 375 MW to be added by 1980, we have assumed 60% (225 MW) will be in the AQCR, since 60% of Central Hudson's present load is in the region. Thus, 225 MW will be assumed to be located at the Danskammer plant in Roseton.

Of the 235 MW required by 1985, it is assumed that 60% or 140 MW will also be located at Danskammer.

For the increment required by the year 2000, it is assumed to be in nuclear additions.

Orange and Rockland

1974 Capability - 1,037 Megawatts

Year	Peak Demand	Peak Plus 18% Reserve	Existing Plus Planned Capacity	Gap
1980	966	1,140	1,191	-
1985	1,347	1,590	1,571	18
2000	2,740	3,235	1,571	1,662

Existing plans include			
	uprating of Lovett #4	8 MW	1975
	Gas Turbines	146	1980
	1/3 of Sterling Nuclear	380	1982

It is assumed the capacity needed in 2000 will be nuclear.

New York City Step 5 cont.

Long Island Lighting Company

1974 Capability - 3,457 Megawatts

Year	Peak Demand	Peak Plus 18% Reserve	Existing Plus Planned Capacity	Gap
1980	4,170	4,920	5,027	-
1985	5,250	6,185	7,327	-
2000	8,540	10,075	7,327	2,750

Company plans for expansion up to 1984 split as follows:

Nuclear	81%
Conventional steam	11
Turbine	8

It is assumed the 2,750 MW required will be allocated in roughly the same proportion:

Nuclear	2,225 MW
Conventional steam	386 "
Turbine	140 "

The capacity of the conventional steam unit was varied slightly to conform to the existing three units at Northport, where this one will be located.

Turbines are assumed to be located at Holbrook, site of existing turbines.

Step 7

The same emission factors as Step 2.

NEW YORK STATE

Step 1

Fuel use data for facilities and points within facilities were derived from the following sources: the 1970 NEDS inventory, FPC Form 67, electric utility company 149-B reports and personal communications. Steam-Electric Power Plant Factors, and the 1974 NEDS inventory.

Step 2

EMISSION FACTORS FOR POWER PLANTS, EXTERNAL COMBUSTION

	FUEL FUEL	
Pollutant	RESIDUAL OIL $lb/10^3$ gal	NATURAL GAS $lb/10^6$ cu.ft.
Particulates	10(s) + 3	10.
Sulfur Oxides	157(s)	0.6
Nitrogen Oxides	50,105*	300,700**
Hydrocarbons	1	1
Carbon Monoxide	5	17

Source: AP-42

EMISSION FACTORS FOR POWER PLANTS, INTERNAL COMBUSTION

	FUEL	
Pollutant	DISTILLATE OIL $lb/10^3$ gal	NATURAL GAS $lb/10^6$ cu.ft.
Particulates	5.0	14.0
Sulfur Oxides	3.5	5.2
Nitrogen Oxides	67.8	413.0
Hydrocarbons	5.57	42.0
Carbon Monoxide	15.4	115.0

Source: AP-42

New York State cont.

Step 4

Allowable emissions were calculated from the Official Compilation of Codes, Rules and Regulations of the State of New York, Title 6, Chapter III, Part 225, Fuel Composition and Use, and Part 227, Stationary Combustion Installations.

It was assumed that all sources which were not in compliance in 1974 would achieve compliance before 1980.

Step 5

Assumptions applicable to all sectors of the Region are reported in New Jersey, Step 5. A summary of reasoning by which fuel type and location allocations were made is reported in New York City, Step 5.

Step 7

The same emission factors as Step 2.

FAIRFIELD COUNTY

All Steps

Since Connecticut data were contained in the AQDM file, electric generating emissions were extrapolated for 1974 and 1980 from the AQDM 1972, 1975, and 1978 data and carried over for 1985.

P.2 INDUSTRIAL PROCESSES

Update Level: 3 [pp. 78-79, Guidelines, Vol. 7]
Projection Level: 1 [pp. 105-108, Guidelines, Vol. 7]
Allocation Order: 1 [pp. 96-97, Guidelines, Vol. 13]

Substance and sequence of steps are given in the work chart. The following details are provided for those steps where procedures are not obvious.

Step 3

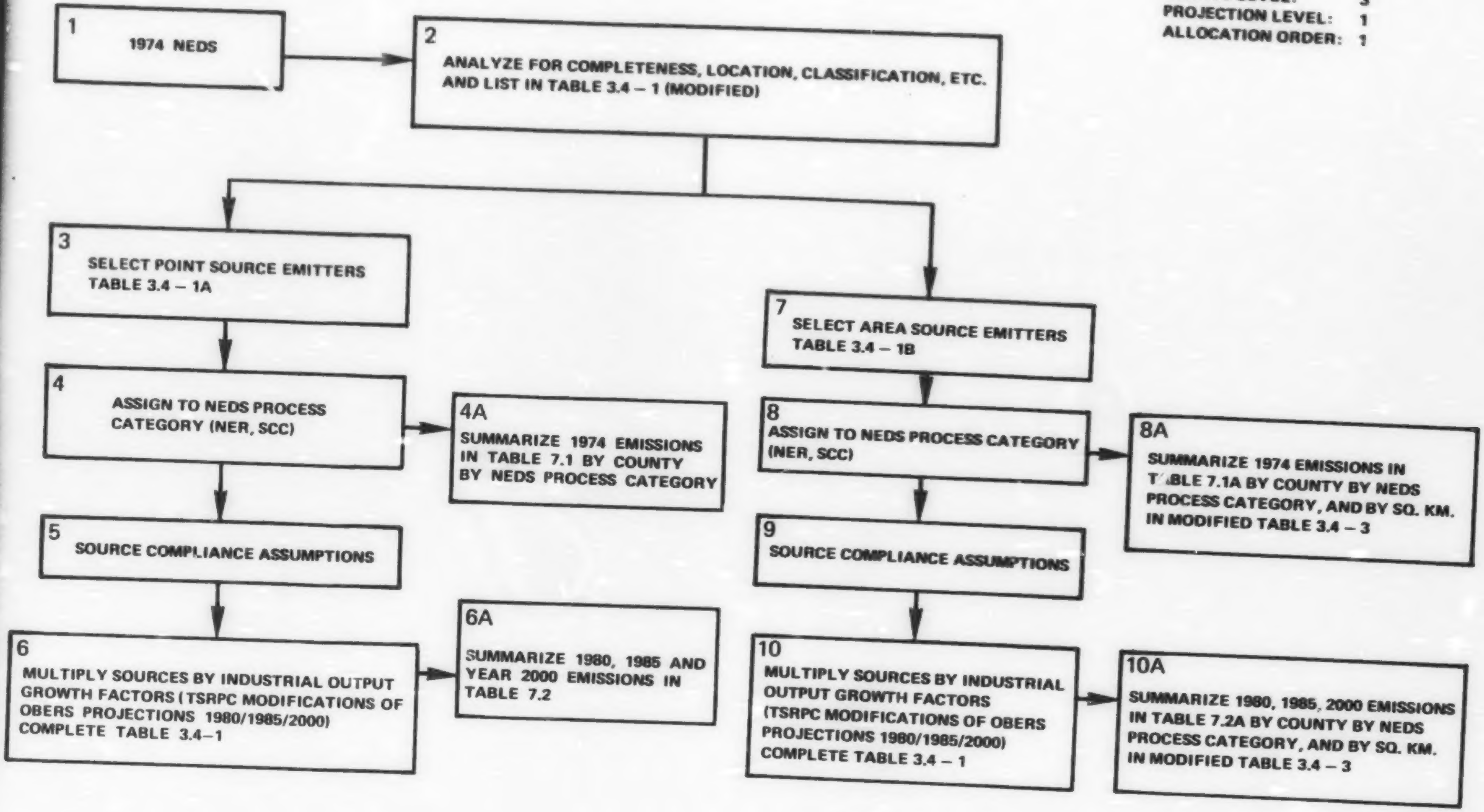
For New Jersey and New York City, process emissions which are part of facilities which emit 100 T/Y or more of particulates or sulfur oxides were considered point sources. But for New York State (excluding New York City) process emissions which are part of facilities which emit 25 T/Y or more of particulates, sulfur oxides, or hydrocarbons were considered point sources.

Regarding industrial process emissions from establishments not listed in the state NEDS files, there is some evidence that these would be insignificant residues and thus Tri-State did not take the considerable extra time required to carry out subcounty allocations. If time and employment data were available the weight of this residue could be more precisely estimated. Employment

P2 INDUSTRIAL PROCESS

(POINT AND AREA SOURCES)

UPDATE LEVEL: 3
PROJECTION LEVEL: 1
ALLOCATION ORDER: 1


1 1974 NEDS
2 ANALYZE FOR COMPLETENESS, LOCATION, CLASSIFICATION, ETC. AND LIST IN TABLE 3.4 – 1 (MODIFIED)
3 SELECT POINT SOURCE EMITTERS TABLE 3.4 – 1A
4 ASSIGN TO NEDS PROCESS CATEGORY (NER, SCC)
4A SUMMARIZE 1974 EMISSIONS IN TABLE 7.1 BY COUNTY BY NEDS PROCESS CATEGORY
5 SOURCE COMPLIANCE ASSUMPTIONS
6 MULTIPLY SOURCES BY INDUSTRIAL OUTPUT GROWTH FACTORS (TSRPC MODIFICATIONS OF OBERS PROJECTIONS 1980/1985/2000) COMPLETE TABLE 3.4–1
6A SUMMARIZE 1980, 1985 AND YEAR 2000 EMISSIONS IN TABLE 7.2
7 SELECT AREA SOURCE EMITTERS TABLE 3.4 – 1B
8 ASSIGN TO NEDS PROCESS CATEGORY (NER, SCC)
8A SUMMARIZE 1974 EMISSIONS IN TABLE 7.1A BY COUNTY BY NEDS PROCESS CATEGORY, AND BY SQ. KM. IN MODIFIED TABLE 3.4 – 3
9 SOURCE COMPLIANCE ASSUMPTIONS
10 MULTIPLY SOURCES BY INDUSTRIAL OUTPUT GROWTH FACTORS (TSRPC MODIFICATIONS OF OBERS PROJECTIONS 1980/1985/2000) COMPLETE TABLE 3.4 – 1
10A SUMMARIZE 1980, 1985, 2000 EMISSIONS IN TABLE 7.2A BY COUNTY BY NEDS PROCESS CATEGORY, AND BY SQ. KM. IN MODIFIED TABLE 3.4 – 3

of listed sources could be compared with the residue of employment at non-listed sources to test the validity of the assumption above.

Steps 5 and 6

Assume that sometime between January 1, 1975 and December 31, 1979, sources come into compliance. Therefore, if estimated emissions are greater than allowable emissions, estimated emissions are set equal to allowable emissions. If estimated emissions are equal to or less than allowable emissions, then these sources are already in compliance. Projection year emissions are calculated for each source by

$$E_{ij} = E_{ik} \times G_{kj}$$

where E_{ij} = emissions for source i in year j (j = 1980, 1985, 2000)
E_{ik} = emissions for source i in year k (k = 1974)
G_{kj} = growth factor from year k to j ($k \rightarrow j$ = 1974 to 1980, 1974 to 1985, 1974 to 2000)

PROJECTIONS OF INDUSTRIAL OUTPUT

The projection procedure recommended by EPA involves determining growth factors for each of 13 NER process categories. These generally coincide with the two-digit SIC's (Standard Industrial Classification Codes) manufacturing industries and in some cases with the combined industries. In projecting manufacturing activities by two-digit level, EPA also suggested that OBERS projections be used if no better local data were available.

However, a careful review of OBERS projections of the manufacturing sector for the Tri-State Region indicated that even their slowest growth projection (Series E) appears to be unrealistically high. Actually, the Region's

Steps 5 and 6 - cont.

post-1970 manufacturing employment performance has been one of continual decline in both absolute and relative terms. Moreover, in manufacturing activities the Region has been severely lagging behind the nation for quite some time. These phenomena have led Tri-State to a downward adjustment of long-term regional growth factors of manufacturing sectors.

The projection method used in estimating the regional manufacturing output, from which the industrial growth factors were developed, involved the following processes: 1) The control total for the Region's manufacturing sector as a whole (see Appendix IV); 2) the disaggregation of the control total to more detailed industries (the two-digit SIC level) via analysis of the regional location quotient (LQ); 3) the derivation of the Region's productivity level by two-digit industry; and 4) the computation of industrial output.

The basic input data used in disaggregating the regional control total and in obtaining productivity relatives were those of the Census of Manufacturing (1958, 1963, 1967, and 1972). From these sources, employment and value-added figures for each of two-digit SIC levels were first assembled for both the U.S. and the Region. Work tables showing the various stages of analyses are available in the Socio-Economic Development Section at Tri-State.

The next step was to establish the historical relationships between the U.S. and the Region in terms of industrial-mix and productivity relatives. The industrial-mix relationships were obtained by computing the ratio: each two-digit industry's percent share of total regional manufacturing sector to that share of the total U.S. manufacturing sector. This provided numerical values of the regional location quotient by each industry with the national value of each industry being unity. These historical LQ ratios by industry were further extrapolated independently, on the basis of trend, to each of the target years.

Graphs showing extrapolated LQ ratios are available in work files in the Socio-Economic Development Section at Tri-State. The projected regional LQ ratios obtained in this way were then applied to the projected national two-digit manufacturing distribution as derived from OBERS (Series E).

Through this process, including a forcing to 100 percent to meet the control total, the projected regional industrial mix for each of target years was obtained, on which base the projected regional manufacturing employment total was disaggregated. A similar procedure was employed to project the productivity relatives by relating the Region's value added per employee to that of the U.S., and by extending them to future years. The projected productivity relatives were applied to OBERS projections of national output per worker to make adjustment for the regional productivity.

Finally, by multiplying each of the projected regional two-digit level productivity relatives by the corresponding industry's employment, the industrial output figures for the Region were calculated. Graphs showing extrapolations of these productivity relatives are available in work files in the Socio-Economic Development Section at Tri-State.

The two-digit SIC figures were then converted to 13 NER process categories, based on the identification guide lines provided by EPA. The results of these computations are shown in the accompanying table (P 2/6).

Step 8A

Allocate source industrial process emissions directly to their respective square kilometers through U.T.M. coordinates.

Industrial Output Growth Factors for Tri-State Region

(Growth index: 1974 = 1.000)

Industrial Sectors	1974	1980	1985	2000
Chemical Mfg	1.000	1.297	1.519	2.513
Food/Agriculture	1.000	1.002	1.004	1.165
Primary Metals	1.000	0.840	0.840	0.862
Secondary Metals	1.000	0.840	0.840	0.862
Mineral Products	1.000	1.151	1.288	1.868
Petroleum	1.000	1.107	1.188	1.531
Wood Products	1.000	1.003	1.094	1.493
Evaporation (Total Mfg)[a]	1.000	1.113	1.224	1.704
Metal Fabrication	1.000	1.100	1.205	1.663
Leather	1.000	1.151	1.288	1.868
Textile	1.000	1.020	1.180	1.550
Inprocess Fuel	1.000	1.113	1.224	1.704
Other	1.000	1.151	1.288	1.868

a. Also used to project fuel use for Total Manufacturing

Source: OBERS projections, modified by TSRPC

For purposes of allocation, "significant growth" was adjudged to be over an average of 1.0% a year. Lower growth was assumed to be assimilated by on-site expansion or technological improvements resulting in productivity raises. Thus, only Chemical Mfg was determined to exhibit significant new growth.

P 3 INCINERATORS (MUNICIPAL)

Update Level: 3 [p. 95, Guidelines, Vol. 7)

Projection Level: 3 [p. 146, Guidelines, Vol. 7]

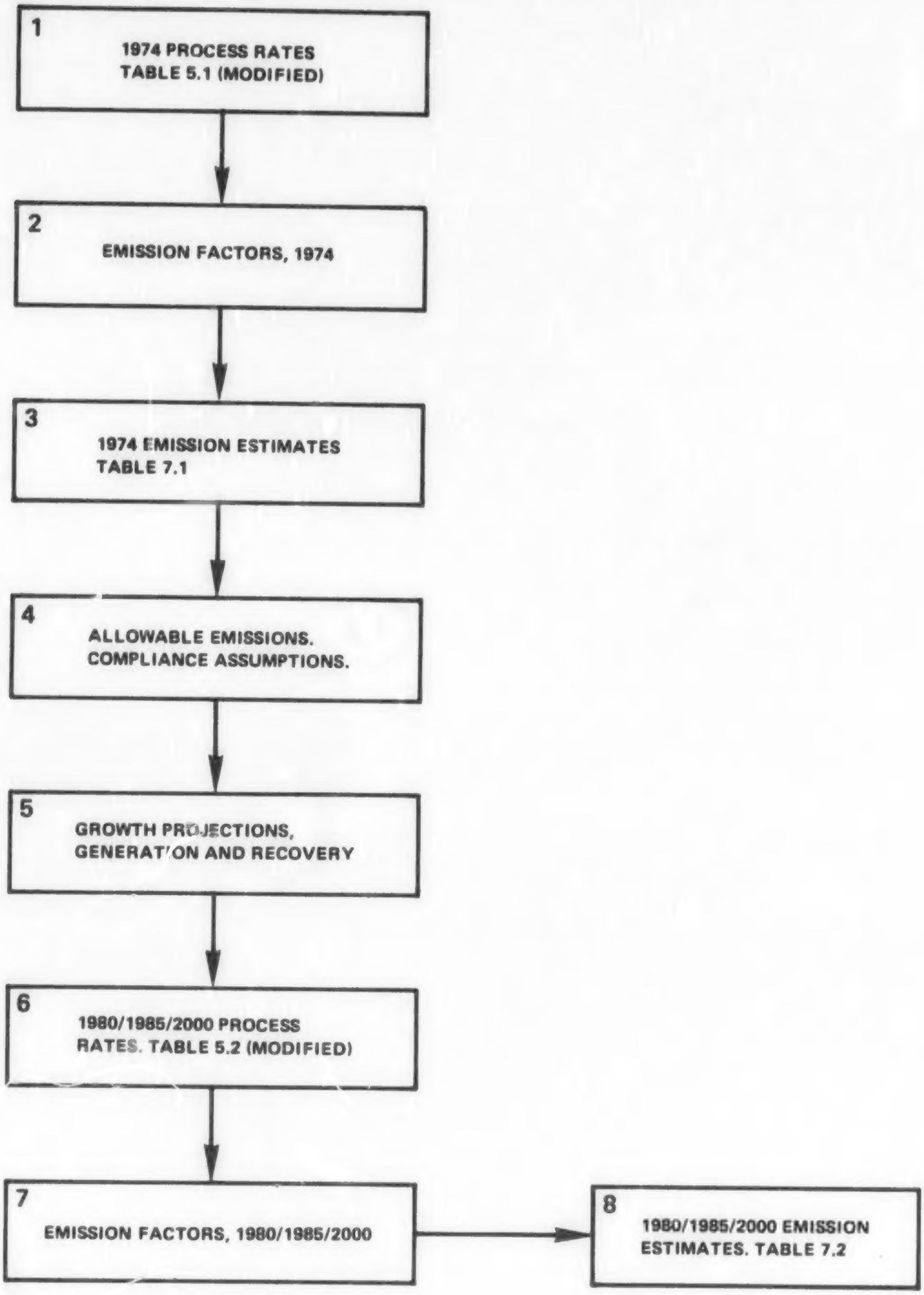
The municipal incinerator point source inventories for base year 1974 and projection years were compiled according to the steps illustrated in the work chart. Additional details, where needed, are supplied below. These include several exceptions arising because solid waste management varies considerably among states, counties, and localities. No private incinerators emit more than 100 t/yr and therefore all are distributed as area sources.

NEW JERSEY

No input data was provided in the New Jersey NEDS file and no calculations were made.

P 3 INCINERATORS – (MUNICIPAL)

(POINT SOURCE)


1
1974 PROCESS RATES
TABLE 5.1 (MODIFIED)
2
EMISSION FACTORS, 1974
3
1974 EMISSION ESTIMATES
TABLE 7.1
4
ALLOWABLE EMISSIONS.
COMPLIANCE ASSUMPTIONS.
5
GROWTH PROJECTIONS,
GENERATION AND RECOVERY
6
1980/1985/2000 PROCESS
RATES. TABLE 5.2 (MODIFIED)
7
EMISSION FACTORS, 1980/1985/2000
8
1980/1985/2000 EMISSION
ESTIMATES. TABLE 7.2

NEW YORK CITY

Step 1

Process rate data were derived from the 1972 IPP inventory supplied by the New York City Department of Air Resources, and from data from the New York City Department of Sanitation.

Step 2

Emission factors for refuse incinerators were obtained from AP-42, with the following exception for particulate emissions from incinerators with settling chambers and water spray systems. For New York City, the particulate

New York City Step 2 cont.

emission factor specified by the EPA in AP-42 was shown by a series of stack tests on city incinerators to overestimate the emissions. As a result, a new value was calculated for use in predicting emissions from New York City incinerators. The new value--13.7 lb/ton--is slightly below the 14.0 lb/ton suggested by EPA.

Steps 4 and 5

New York City - Data on the annual tonnage of refuse collected in New York City over the past 15 years were analyzed by the Solid Waste Task Force and projections of future generation rates were made for various annual per capita increase in population in New York City through 1985 and a less than 1% increase in the generation of refuse as the most probable scenario. These factors, when combined with 1974 process rates, indicate no preceptible change in incineration process rates for the 1974-1985 period.

It was assumed that sources not in compliance in 1974 would achieve compliance before 1984. Allowable emissions were calculated using emission standards contained in the Administrative Code of the City of New York, Chapter 57, Article 9, Section 1403.2-9.09. The emission estimates for the remaining pollutants are not expected to change from 1974 levels as control devices are not planned and the composition of the refuse is not expected to change substantially.

Incinerator emissions for the year 2000 are assumed to equal zero because currently operating incinerators will be obsolete and alternative waste recovery systems will be processing most of the refuse generated.

Step 7

Emission factors are from AP-42, except for particulates, which were supplied by NYC DAR.

NEW YORK STATE

Step 1

These data were obtained from a variety of sources including records kept by individual townships on incineration volumes during the base year. Where township records were not available, data from the New York State Department of Environmental Conservation (DEC) Regional Offices were substituted. When data concerning the operation characteristics of each source were not tabulated on the NEDS form, data from operating permit files in DEC offices were obtained. In some cases, where source data were not available directly, stack test data were used to complete the file.

Step 2

Emission factors were obtained from AP-42.

Steps 4 to 8

Nassau-County - The projection of future incineration rates was developed from available studies on solid waste and information from discussions with solid waste engineers for Nassau County. Many of the incinerators operating in 1974 were not in compliance with EPA regulations. Only a few have been upgraded to meet regulations and those that are not upgraded by 1977, will be closed. Sources that will continue to operate will meet EPA regulations by 1980 and the emission rates for these sources have been computed on the basis of allowable emission and process rates. Process rates have been projected for 1980 on the basis of population increases in the areas served by the incinerators in operation. Actual particulate emission rates are those measured outputs reported by NYS DEC from controlled equipment, or, if these are lacking, calculated from AP-42.

Solid waste recovery systems will play an important role in the processing of future solid waste generated in Nassau after 1980. Incinerator process rates for 1985 are, therefore, held at 1980 levels. This anticipates reductions in refuse incinerators because alternative waste recovery systems will absorb the increased generation caused by increases in population. By the year 2000, solid waste recovery systems are projected to process all refuse in the area and all incineration will cease.

Suffolk, Westchester, Dutchess, Orange, and Rockland counties - Most municipal incinerators should be phased out of operation by 1980. Those that remain will probably operate near 1974 levels and must comply with particulate emission regulations. Again, by the year 2000, all incinerators are assumed

New York State Steps 4 to 8 cont.

to be obsolete and solid waste recovery systems would have become operational. Some of the government incinerators in these counties were removed from the NYS NEDS file because the emissions from these sources were negligible.

FAIRFIELD COUNTY

All Steps

The AQDM data on incinerators were extrapolated for 1974 and 1980 from the AQDM dates (1972, 1975, and 1978), and carried over for 1985.

RECOMMENDATIONS

The contract for the compilation of this inventory did not specifically intend Tri-State to exhaustively examine the source data tabulated on the NEDS coding forms. However, Tri-State did perform considerable checking as described in the steps above. This showed that existing files were seriously inadequate. Although Tri-State improved the existing files, corrections to some records are still necessary before modelling efforts can begin. It would be desirable to apply a preliminary test to calculate the impact of errors in the incinerator files on the total error involved in the concentration predictions. Once this comparison is complete, decisions can be made about additional efforts in updating and correcting the current incinerator file.

Solid waste recovery systems have been cited throughout this presentation to absorb the responsibility for solid waste disposal. These systems also have associated pollutant emissions that have not been accounted for in the current inventory. In addition to refuse, alternative sewage sludge methods are also being contemplated for the Tri-State region (Sewage Sludge Disposal Management Program, June 1976, Interstate Sanitation Commission). These also have associated emissions that have not been recognized in this inventory. Therefore, before computer modelling of the inventory is initiated, it would be appropriate to include the additional sources of pollutants from solid waste recovery systems and sewage sludge disposal systems.

P4 POINT SOURCE FUEL COMBUSTION

Update Level: 3 [p. 79, Guidelines, Vol. 7]

Projection Level: 2 [p. 123, Guidelines, Vol. 7]

Substance and sequence of steps are given in the work chart. The following details are provided for those steps where procedures are not obvious.

Step 1

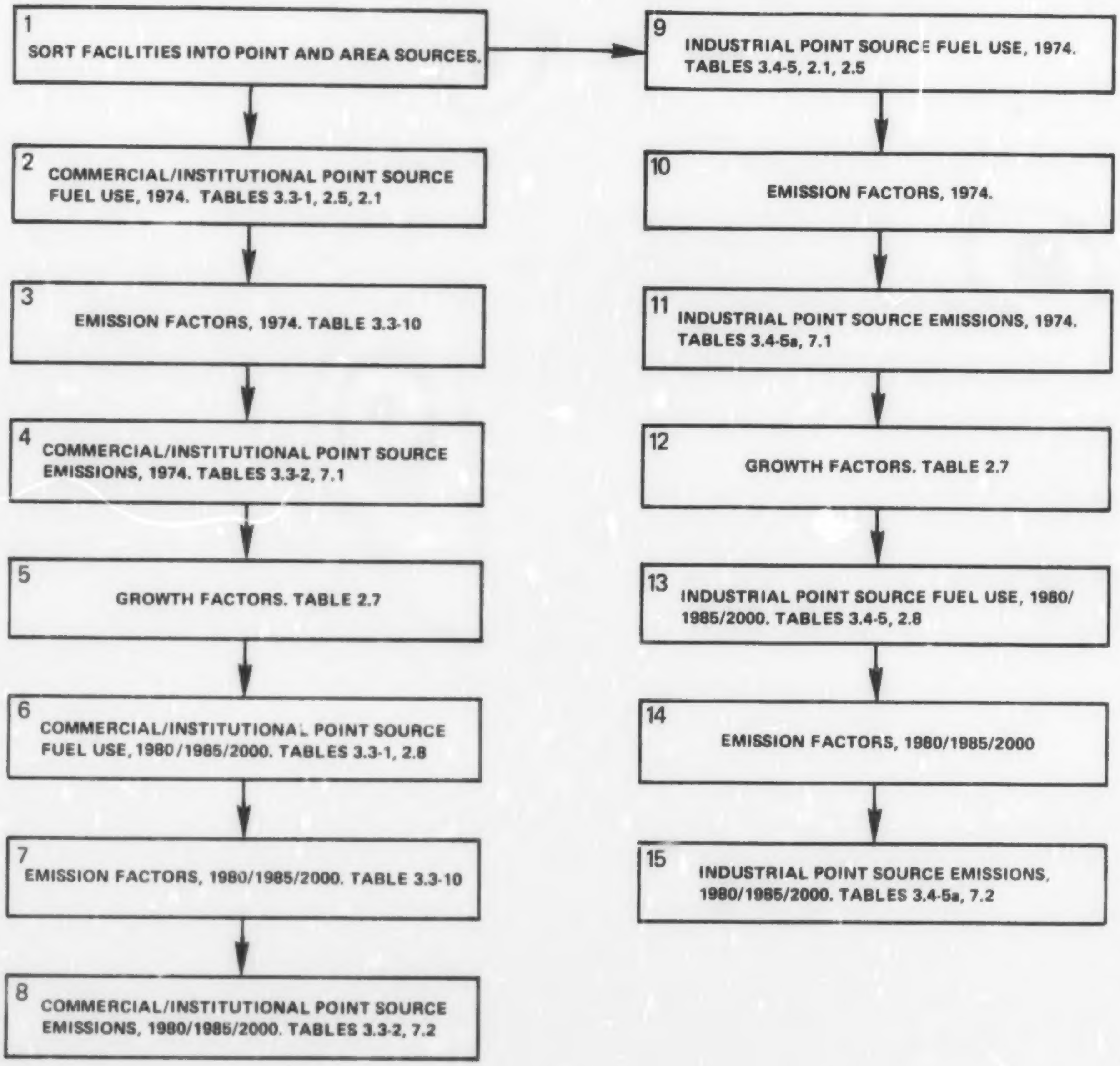
Definitions of point and area source facilities for New Jersey, and New York State are listed below:

	New Jersey	New York State
Point	Facility emits 100 tons/year of more of particulates, or sulfur oxides.	Facility emits 25 tons/year or more of particulates, sulfur oxides, or HC.
Area	Facility emits less than 100 tons/year of any one of these pollutants.	Facility emits less than 25 tons/year or any one of these pollutants.

P4 POINT SOURCE FUEL COMBUSTION (COMMERCIAL/INSTITUTIONAL & INDUSTRIAL)

P 4 / 2

LEVEL: 3
ORDER : : 2


1 SORT FACILITIES INTO POINT AND AREA SOURCES.
2 COMMERCIAL/INSTITUTIONAL POINT SOURCE FUEL USE, 1974. TABLES 3.3-1, 2.5, 2.1
3 EMISSION FACTORS, 1974. TABLE 3.3-10
4 COMMERCIAL/INSTITUTIONAL POINT SOURCE EMISSIONS, 1974. TABLES 3.3-2, 7.1
5 GROWTH FACTORS. TABLE 2.7
6 COMMERCIAL/INSTITUTIONAL POINT SOURCE FUEL USE, 1980/1985/2000. TABLES 3.3-1, 2.8
7 EMISSION FACTORS, 1980/1985/2000. TABLE 3.3-10
8 COMMERCIAL/INSTITUTIONAL POINT SOURCE EMISSIONS, 1980/1985/2000. TABLES 3.3-2, 7.2
9 INDUSTRIAL POINT SOURCE FUEL USE, 1974. TABLES 3.4-5, 2.1, 2.5
10 EMISSION FACTORS, 1974.
11 INDUSTRIAL POINT SOURCE EMISSIONS, 1974. TABLES 3.4-5a, 7.1
12 GROWTH FACTORS. TABLE 2.7
13 INDUSTRIAL POINT SOURCE FUEL USE, 1980/1985/2000. TABLES 3.4-5, 2.8
14 EMISSION FACTORS, 1980/1985/2000
15 INDUSTRIAL POINT SOURCE EMISSIONS, 1980/1985/2000. TABLES 3.4-5a, 7.2

COMMERCIAL/INSTITUTIONAL

New Jersey

Step 3

Emission factors for commercial/institutional natural gas, distillate oil, and residual oil combustion are the same as those in the respective area source sections.

Step 5

	Growth Factors			
County	1974	1980	1985	2000
Bergen	1.000	1.038	1.104	1.301
Essex	1.000	1.002	1.005	1.095
Hudson	1.000	0.993	1.040	1.247
Middlesex	1.000	1.096	1.205	1.505
Monmouth	1.000	1.088	1.161	1.403
Morris	1.000	1.057	1.118	1.324
Passaic	1.000	0.996	1.014	1.143
Somerset	1.000	1.020	1.097	1.327
Union	1.000	0.997	0.995	1.024

Step 7

The same emission factors as in Step 3.

Commercial/Institutional cont.

New York City

Step 3

Emission factors for commercial/institutional natural gas, distillate oil, and residual oil combustion are the same as those in the respective area source sections (A1, 2, 3).

Step 5

	Growth Factors			
County	1974	1980	1985	2000
Bronx	1.000	0.982	1.019	1.166
Kings	1.000	0.984	0.979	1.036
New York	1.000	1.046	1.092	1.109
Queens	1.000	0.998	1.003	1.056
Richmond	1.000	1.213	1.390	1.836

Step 7

The same emission factors as in Step 3.

Commercial/Institutional cont.

NEW YORK STATE

Step 3

Emission factors for commercial/institutional natural gas, distillate oil, and residual oil combustion are the same as those in the respective area source sections (A1, 2, 3).

Step 5

County	Growth Factors 1974	1980	1985	2000
Dutchess	1.000	1.068	1.126	1.330
Nassau	1.000	0.989	0.999	1.092
Orange	1.000	1.148	1.271	1.618
Putnam	1.000	1.007	1.050	1.302
Rockland	1.000	1.057	1.105	1.272
Suffolk	1.000	1.079	1.147	1.286
Westchester	1.000	0.999	1.037	1.162

Step 7

The same emission factors as in Step 3.

Commercial/Institutional cont.

Fairfield County

All Steps

Commercial/industrial points emissions listed in the AQDM file were extrapolated for the desired target years and carried over for 1985.

INDUSTRIAL

New Jersey, New York City, New York State

Step 10

Emission factors for industrial natural gas, distillate oil, and residual oil combustion are the same as those in the respective area source sections (A1, 2, 3).

Step 12

County	Growth Factors			
	1974	1980	1985	2000
All counties	1.00	1.11	1.22	1.70

See P 2/3 for method

Step 14

The same emission factors as Step 10.

FAIRFIELD COUNTY

All Steps

Emissions were extrapolated for desired target years and for 1985 were carried over.

APPENDICES

I METRIC CONVERSION OF LAND USE FILES
II LIST OF SUPPLEMENTARY STUDIES
III LIST OF TABLES PRODUCED
IV METHODS OF ESTIMATING POPULATION, HOUSING UNITS, AND FLOOR SPACE
V METHODS OF ESTIMATING EMPLOYMENT

APPENDIX I

METRIC CONVERSION OF LAND USE FILES

Tri-State's land use data for current and forecast years are reported by square miles. The E.P.A. Air Quality Inventory required these data to be reported by square kilometers.

1. Grid Systems

   a. Square Mile Grid

   The square mile grid cell is a unit of the Tri-State X-Y grid system which is oriented to the street pattern of Manhattan. The X coordinates are approximately 30° east of north with the X500 coordinate aligned with 8th Avenue. The Y500 coordinate intersects the X500 coordinate at 61st Street. The coordinate units are in terms of miles and fractions of miles. (Figure 1.)

   b. Universal Transverse Mercator Grid (square kilometer)

   The Universal Transverse Mercator (UTM) system divides the world into sixty zones, each covering 6° longitude. Zones are numbered from west to east beginning at 180° longitude. The Tri-State Region lies in Zone 18. The UTM grid is established by designating the middle longitude of the zone as the central meridian or X coordinate and the equator as the starting Y coordinate. Coordinate values are given in terms of meters and increase to the north and east. The central meridian is called the E (easting) 500,000 meter line and the equator the N(northing) 0 meter line. This designation permits computation of distance without generating negative numbers. The grid as it applies to the Tri-State Region is shown in Figure 2.

2. Conversion Methodology

Initially, the 1963 land use inventory acquired a large variety of land uses. For planning purposes, these had to be condensed later into eight categories and aggregated to a modified square mile grid cell. These data were updated to 1970 and were the basis for forecasting future land usage.

The distribution and location of the various land uses within the square mile is not carried in the computer file. For purposes of conversion, it was necessary to assume that all land uses were equally distributed over the grid cell. The cell was subdivided into 16 equal parts, each assigned 1/16 of the grid's land uses.

Geographic ID

Each grid cell had previously been assigned to a specific community (usually MCD) within a specific county and given an appropriate identifying code. This code was attached to each of the 16 subdivided parts of every cell.

The square mile grid cell is identified by the X-Y coordinates of the lower left (southwest) corner. Each sixteenth unit was also identified by its southwest corner coordinates.

Rotation

Then the Tri-State X-Y coordinates of the "sixteenths" were translated by computer formula ("rotated") to the UTM Easting and Northing coordinates. The data in the rotated units were then aggregated to (1) one square kilometer (1 km^2) grid cells where all rotated segments carried the same county and community codes and (2) to partial km^2 grid cells for each unique county and community portion received from the sixteenth square mile cell. The partial km^2 grid cells were re-summed to 1-km^2 grids and assigned the county and community codes from the partial grid containing the larger area.

3. Evaluation

The effect of this conversion method on the reliability of 1970 land quantities and land use categories was evaluated in two ways:

- by comparing the square mile data to the square kilometer data at state and sub-region (county and planning region) levels;
- by comparing square kilometer data values to ground truth: aerial photographs.

(Since the conversion merely changed the land use values from one orientation to another, regional totals are not affected.)

a. State and Sub-Region Comparison of Land Area

- There was a negligible effect, just over 0.10%, at State level, as shown in Table 1.

- At subregion level, there was greater variance than at state level. Fifteen subregions had less land area as a result of conversion; twelve had more. The percent difference on the minus side ranged 0.10% (Union County) to 4.21% (Valley Planning Region), the average being 0.98%. The percent difference on the plus side varied from 0.09% (Suffolk County) to 2.72% (Putnam County) with an average of 1.04%. Table 2 ranks the subregions by percent difference.

b. Examination of Selected KM^2 Grids

Two hundred forty four KM^2 grids were randomly selected from the converted file. These were located and outlined on aerial photographs. A visual photo interpretation was made of the following land uses: Residential; Non-Residential; Vacant (including Recreation and special uses); Water (including Swamp). Percent of area found in each group was estimated and recorded. Street area was estimated to be 20% of the total of observed Residential and Non-Residential areas. Three technicians independently recorded their observations of all selected grid cells, and these readings were then averaged.

The percent of land in each land use category observed in the aerial photo was compared to the parallel value in the converted KM^2 cell. The average variance for all land use categories within sample cells was then derived. For example:

Variance in :	Non-Residential Use	1.0%
	Residential Use	6.0%
	Street Use	2.0%
	Vacant-type Use	7.0%
	Water and Swamp	0.0%
Average Variance in all categories		3.2%

The average of these variances for all sample KM^2 cells was 5.8%, ranging from 0% to 40.0%. Table 3 shows the distribution of the sample by percent variance.

The results of the comparison by each land use category are shown in Table 4.

In the course of the comparison, some of the converted file values were found to be less than the aerial photo observations and some above. Table 5 displays the distribution of the cells between plus and minus.

TABLE 1 : COMPARISON OF TOTAL LAND BY STATE
1970 Tri-State Square Mile vs UTM Kilometer

(Values in Square Miles)

	Tri-State Sq. Mi.	UTM Sq. KM	Difference	Per Cent Difference
Connecticut	1,411.4	1,409.2	(2.2)	(.16)
New Jersey	2,256.7	2,254.1	(2.6)	(.12)
New York	3,965.5	3,970.3	4.8	.12
Region	7,633.6	7,633.6		

TABLE 2: COMPARISON OF TOTAL LAND AREA BY SUBREGION --

1970 Tri-State Square Mile vs UTM Kilometer

(Values in Square Miles)

	Decrease in Total Land			
	Tri-State Sq. Mi.	UTM Sq KM	Difference	Per Cent Difference
Union	103.31	103.20	(0.11)	(0.10)
Rockland	179.39	179.10	(0.29)	(0.16)
Bergen	234.91	234.20	(0.71)	(0.31)
Essex	125.98	125.55	(0.43)	(0.33)
Nassau	284.38	283.41	(0.97)	(0.34)
Somerset	303.71	302.31	(1.40)	(0.46)
Dutchess	793.59	789.46	(4.13)	(0.52)
Housatonic Valley	323.76	322.00	(1.76)	(0.54)
Richmond	57.14	56.67	(0.47)	(0.82)
Queens	108.72	107.79	(0.93)	(0.86)
Central Naugatuck Valley	309.77	306.76	(3.01)	(0.97)
Southwestern	213.64	210.74	(2.90)	(1.36)
Kings	72.35	71.17	(1.18)	(1.64)
Passaic	187.10	183.30	(3.80)	(2.03)
Valley	56.17	53.81	(2.36)	(4.21)

	Increase in Total Land			
	Tri-State Sq. Mi.	UTM Sq. KM	Difference	Per Cent Difference
Suffolk	917.05	917.88	0.83	0.09
Monmouth	475.03	475.89	0.86	0.18
Orange	809.16	811.16	2.00	0.25
Middlesex	311.67	312.54	0.87	0.28
Morris	466.96	468.79	1.83	0.39
Westchester	446.04	443.46	2.58	0.58
Hudson	47.99	48.32	0.33	0.67
South Central	370.11	374.52	4.41	1.19
Bronx	43.19	43.87	0.68	1.58
Manhattan	22.24	22.67	0.43	1.94
Greater Bridgeport	137.74	141.29	3.55	2.58
Putnam	234.77	241.15	6.38	2.72

TABLE 3: COMPARISON OF SQUARE KILOMETER CELLS WITH AERIAL PHOTOS
(Number of Cells by Per Cent Variance)

	0-5%	6-10%	11-15%	16-20%	21-25%	26%+
Average Variance of All Land Uses in Square Kilometer	154	47	27	11	2	3

TABLE 4: COMPARISON BY LAND USE CATEGORY
(Number of Cells by Per Cent Variance)

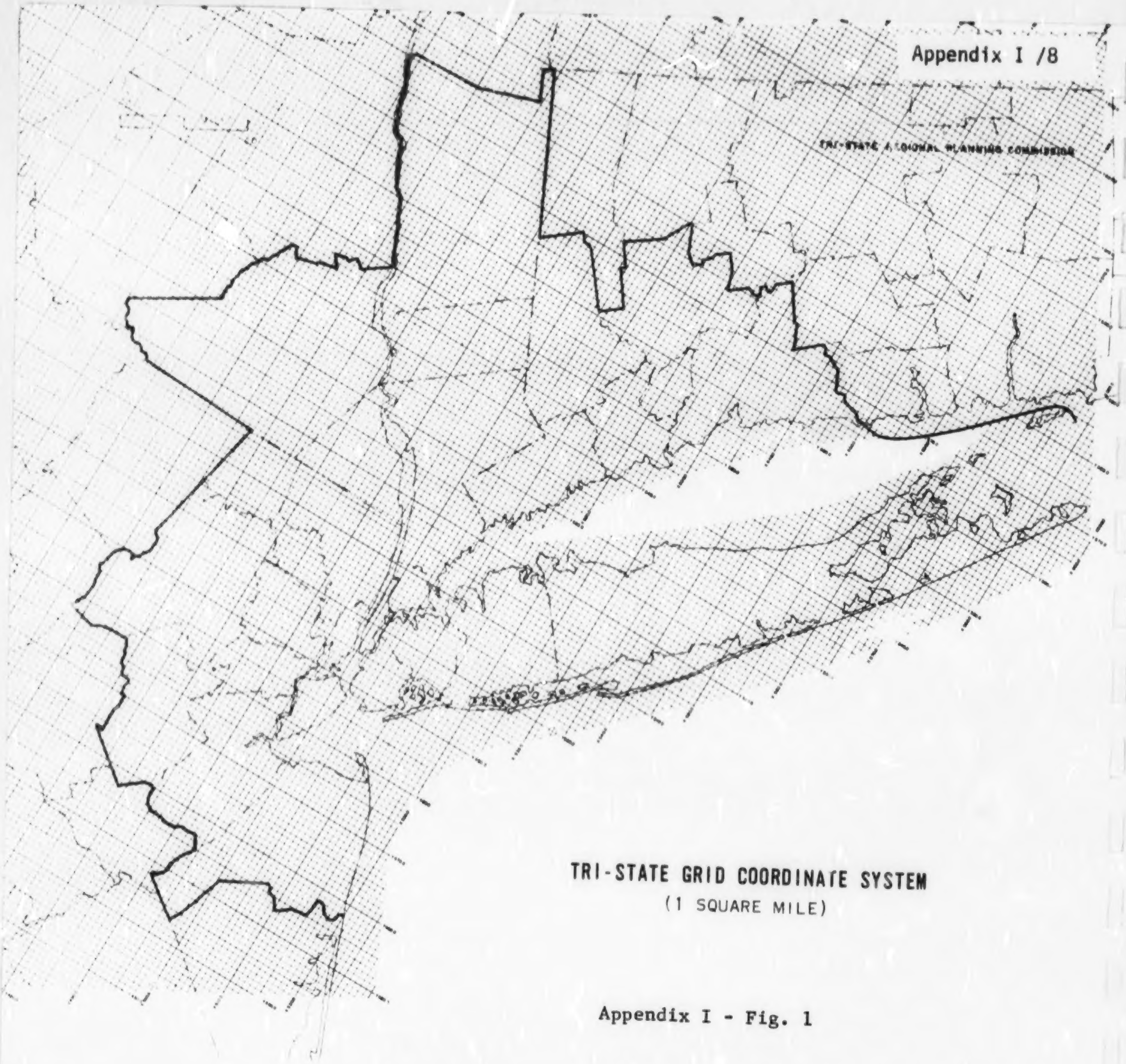
Land Use Category	0-5%	6-10%	11-15%	16-20%	21-25%	26%+
Non-Residential	196	22	6	8	4	8
Residential	146	45	17	15	7	14
Streets	213	17	5	3	1	5
Vacant, Recreation and Special	111	53	24	18	9	29
Water & Swamp	188	23	7	7	3	16

TABLE 5: PLUS & MINUS DISTRIBUTION OF LAND USE VARIANCES
(Number of cells by per cent variance)

Land Use Category		0-5%	6-10%	11-15%	16-20%	21-25%	26%+
Non-Residential	+	143	9	3	4	1	6
	-	53	13	3	4	3	2
Residential	+	110	28	12	9	6	9
	-	36	17	5	6	11	5
Streets	+	156	7	2	3	1	5
	-	57	10	3	0	0	0
Vacant, Recreation	+	64	25	10	7	5	18
and Special		47	28	14	11	4	11
Water & Swamp	+	135	8	4	5	2	6
	-	53	15	3	2	1	10

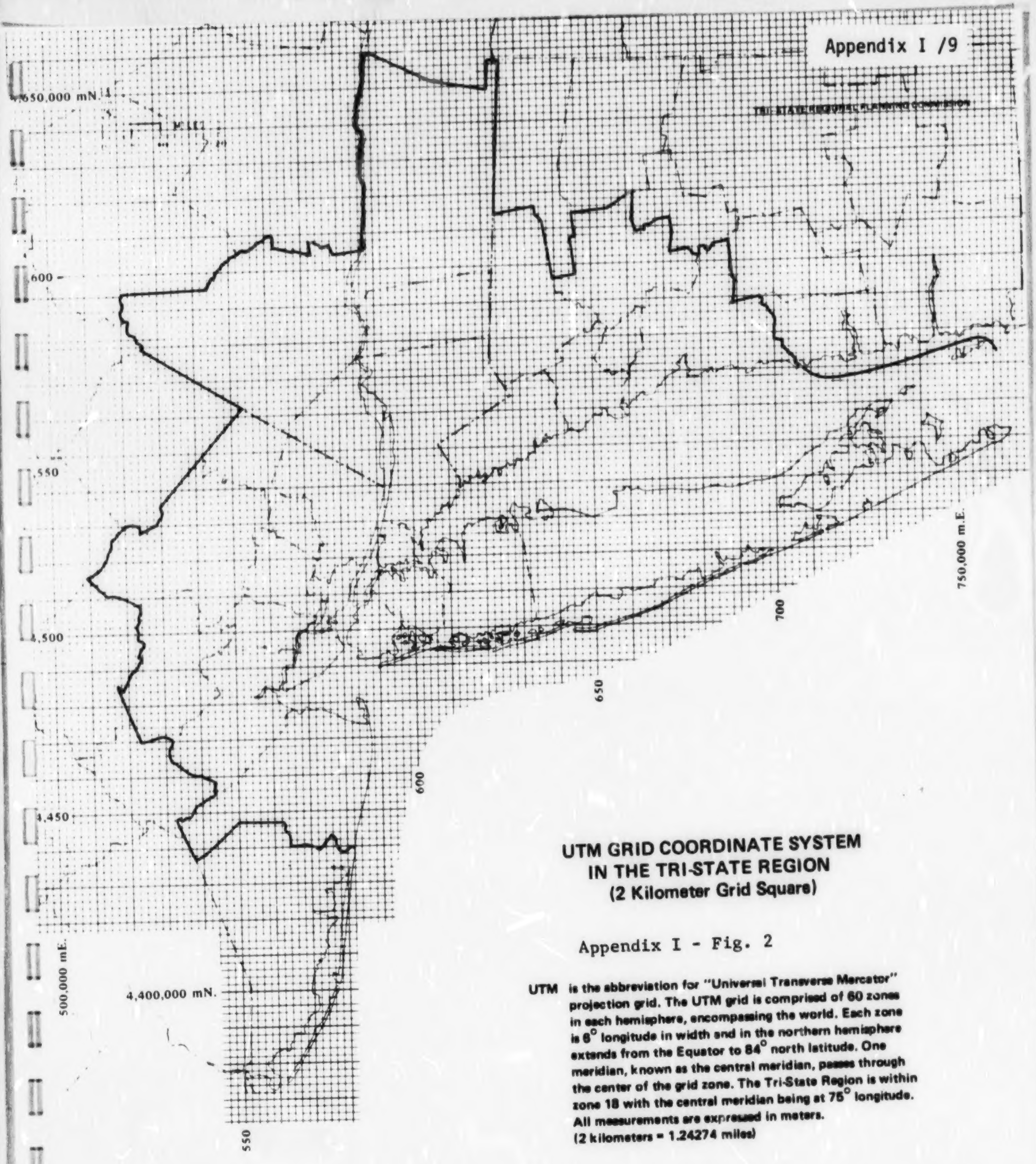
+ = converter grid values greater than value observed in aerial photo.

- = converted grid values less than value observed in aerial photo.


TRI-STATE REGIONAL PLANNING COMMISSION

TRI-STATE GRID COORDINATE SYSTEM
(1 SQUARE MILE)

Appendix I - Fig. 1


TRI-STATE REGIONAL PLANNING COMMISSION
4,650,000 mN.
600
550
4,500
4,450
4,400,000 mN.
500,000 mE.
550
600
650
700
750,000 m.E.

UTM GRID COORDINATE SYSTEM
IN THE TRI-STATE REGION
(2 Kilometer Grid Square)

Appendix I - Fig. 2

UTM is the abbreviation for "Universal Transverse Mercator" projection grid. The UTM grid is comprised of 60 zones in each hemisphere, encompassing the world. Each zone is 6° longitude in width and in the northern hemisphere extends from the Equator to 84° north latitude. One meridian, known as the central meridian, passes through the center of the grid zone. The Tri-State Region is within zone 18 with the central meridian being at 75° longitude. All measurements are expressed in meters. (2 kilometers = 1.24274 miles)

FEB. 1976

APPENDIX II

LIST OF SUPPLEMENTARY STUDIES

These studies are available upon request to Publications Section, Tri-State Regional Planning Commission, 1 World Trade Center, N.Y.C. 10048. Please include a reference to this report in your request.

INTERIM TECHNICAL REPORTS

ITR 1507 and 1508: "Highway Travel Forecasts 1980 Through 2000." March 1977.

ITR 2501: "Regional Temperature Patterns and Their Relation to Planning." Environmental Assessment Series #10. January 1977.

ITR 4212-2461: "Evaluating the Interim Plan II." January 1971.

ITR 4287-2501: "Regional Employment Projections by Major Industry: Years 1985 and 2000." March 1972.

ITR 4351-5401: "The Land Development System for the Tri-State Region, an Overview." January 1976.

ITR 4432-2101: "Cost and Performance Evaluation of Alternate Highway Strategies." April 1974.

ITR 4440-1506: "Employment and Nonresidential Floor Space for Selected Years." May 1974.

ITR 4442-5401: "The Land Allocation System." May 1974.

ITR 4506-1205: "Gasoline Consumption: 1967 and 1972." April 1975.

ITR 4509-1506: "Most Likely Targets for Planned Growth. I - The Region II - The Counties and Planning Regions." January 1976.

ITR 4533-1210: "1974-1975 Housing Changes in the Tri-State Region." September 1975.

ITR 4545-1202: "Regional and County Employment Monitoring: Year 1974." February 1976.

ITR 4572-1205: "Limited Access Highway Status Report: 1975." April 1976.

ITR 4587-1215: "Historical Trends in Electric Energy and Fossil Fuels." January 1977.

ITR 4593-1207: "1975 Highlights of Prime Activities at Major Regional Airports." October 1976.

ANALYSIS NOTES

Analysis Notes 1504: "Projected Demand for Electric Energy and for the Fossil Fuels Required for Generation." May 1976.

Analysis Notes 3402: "Methodology and Analysis of the Tri-State Housing Structure Type Model." January 1975.

Analysis Notes L-009: "Population, Employment and Land Use Forecast Data File Description." June 1976.

Analysis Notes V-230: "Air Pollution Emissions from Aircraft." October 1975.

MISCELLANEOUS

Housing and Neighborhood Quality, Citizen Survey Series 1. Tri-State Regional Planning Commission, October 1975.

Maintaining Mobility: The Plan and Program for Regional Transportation through 2000. Second Edition, November 1976. Tri-State Regional Planning Commission.

Regional Rail Freight, 1974 and the Future. Tri-State Regional Planning Commission, March 1974.

Regional Profile: "Residential Building Trends." October 1975.

Technical Manual 1018-1310: "Basic Land Use Information System." May 1975.

APPENDIX III - LIST OF TABLES PRODUCED

1. Tape and printed listing of land use parameters by square kilometer in counties in the Tri-State region, for the years desired by EPA. The land use parameters are:
    - Population
    - Employment
    - Total housing units
    - Occupied housing units
    - Residential floor space
    - Residential land area
    - Non-residential floor space
    - Non-residential land area
    - 'Other' land area

2. Computer maps of population, employment, and housing units by square mile for the years 1980, 1985, 2000.

County totals of land use parameters for base and future years in the following documents:

3. ITR 4569-1202, 'Population and Vital Statistics: 1974'

4. ITR 4545-1202, 'Regional and County Employment Monitoring: Year 1974'

5. ITR 4533-1210, '1974-1975 Housing Changes in the Tri-State Region'

6. ITR 4509-1506, 'Revised Estimates of Jobs and Population,
    I - The Region: Forecasts.
    II - The Counties and Planning Regions: Projections Based on Plans'

7. Packet of Population, Employment, and Housing for 1970, 1980, 1985, 1990, and 2000, Regional Development Division, January 1976.

8.	Table 1.1	Baseline Industrial Process Emissions - by county	- 1/
9.	Table 2.1	Baseline County Fuel Use	- clerical form
10.	Table 2.6	Baseline County Fuel Use, BTU Equivalents	- clerical form
11.	Table 2.8	Projected County Fuel Use	- clerical form
12.	Table 3.1	Transportation Activity	- clerical form
13.	Table 3.5	Aircraft Activity	- clerical form
14.	Table 5.1	Baseline Solid Waste Disposal	- clerical form
15.	Table 5.2	Projections for Solid Waste Disposal	- clerical form
16.	Table 7.1	County Base Year Emissions Report	- clerical form
17.	Table 7.2	Projected County Emissions Report	- clerical form
18.	Table 3.1-1	Population-Based Allocation Proportions for subcounty areas (km^2)	- included in Table 3.2-10, printed and on tape

19.	Table 3.1-3	Residential Building Size Distribution	- printed and on tape
20.	Table 3.1-4	Residential Fuel Use Distribution	- combined with Table 3.1-7, printed and on tape
21.	Table 3.1-5	Residential Fuel Use Factors by Building Size	- clerical form and in Methodology Report
22.	Table 3.1-6	Annual Residential Fuel Use by Building Size	- clerical form
23.	Table 3.1-7	Residential Fuel Use Allocated to subcounty areas (km^2)	- combined with Table 3.1-4, printed and on tape
24.	Table 3.1-8	Residential Fuel Combustion Emissions Factors	- clerical form and in Methodology Report
25.	Table 3.1-9	Residential Fuel Combustion Emissions Allocated to subcounty areas (km^2)	- printed and on tape
26.	Table 3.2-3	Limited Access Highway Emissions [2]	- printed and on tape
26a	Table 3.2-5	Motor Vehicle Emissions	- " " " "
27.	Table 3.2-6	Airport Emissions	- printed and on tape
28.	Table 3.2-7	Railroad Emissions-Track	- printed and on tape
29.	Table 3.2-8	Railroad Emissions-Yards	- printed and on tape
30.	Table 3.2-9	Sea Vessel Emissions	- printed and on tape
31.	Table 3.2-10	Off Highway Vehicle Emissions	- printed and on tape
32.	Table 3.2-11	Transportation Emissions Allocated to subcounty areas (km^2)	- printed and on tape
33.	Table 3.3-1	Commercial/Institutional Point Source Fuel Use [3]	- printed or clerical form and on tape
34.	Table 3.3-2	Commercial/Institutional Point Source Emissions [3]	- printed or clerical form and on tape
35.	Table 3.3-9	Commercial/Institutional Fuel Use Allocated to subcounty areas (km^2)	- printed and on tape
36.	Table 3.3-10	Commercial/Institutional Fuel Combustion Emission Factors	- clerical form and in Methodology Report
37.	Table 3.3-11	Commercial/Institutional Fuel Combustion Emissions Allocated to subcounty areas (km^2)	- printed and on tape

38.	Table 3.4-1	Point Source Industrial Process Emissions 4/	- printed or clerical form and on tape
39.	Table 3.4-5	Industrial Point Source Fuel Use 4/	- printed or clerical form and on tape
40.	Table 3.4-5a	Industrial Point Source Fuel Combustion Emissions 4/	- printed or clerical form and on tape
41.	Table 3.4-5, modified	Industrial Area Source Fuel Use 5/	- printed and on tape 5/
42.	Table 3.4-8, modified	Industrial Point and Area Source Fuel Combustion Emissions - subarea summary (km^2) 5/	- printed and on tape 5/
43.	Table 3.5-2	Annual Solid Waste Incineration Allocated to subcounty areas (km^2)	- combined with Table 3.5-6, printed and on tape 6/
44.	Table 3.5-3	Solid Waste Incineration Emission Factors	- clerical form and in Methodology Report
45.	Table 3.5-6	Solid Waste Incineration Emissions Allocated to subcounty areas (km^2)	- combined with Table 3.5-2, printed and on tape
46.	Table 3.6-1	Distributed Miscellaneous Source Emissions	- combined with Tables 3.6-2 and 3.1-1, printed and on tape
47.	Table 3.6-2	Isolated Miscellaneous Source Emissions	- combined with Tables 3.6-1 and 3.1-1, printed and on tape

48. Point source files, base year and forecast, in NEDS format - on tape and printed.

49. Area source data by county, base year and forecast, in NEDS format - in clerical form.

50. Point source parameters in AQDM format:
    - printed in emission inventory format as specified in figure 3-B, page 3-13, 'Air Quality Display Model',PB 189 194, November 1969, distributed by NTIS;
    - on tape, separately and combined with area source parameters, in required model input format.

51. Area source parameters in AQDM format:
    - printed in emission inventory format as specified in figure 3-B, page 3-13, 'Air Quality Display Model", PB 189 194, November 1969, distributed by NTIS;
    - on tape, combined with point source parameters, in required model input format.

Notes:

1/ Table 1.1 baseyear data are printed by computer; forecast year data are available from summary on printed forms of Table 3.4-1.

2/ Table 3.2-3 reports only three pollutants from Limited Access Highways for reasons fully explained in the Methodology Report.

3/ Tables 3.3-1 and 3.3-2 were not produced for New Jersey because the data provided to Tri-State contain no Commercial/Institutional point sources. Where these data do exist, they will be included in the NEDS files and AQDM files, on tape.

4/ The data for Tables 3.4-1, 3.4-5, 3.4-5a are included in the NEDS files and AQDM files, on tape.

5/ The area source data reported in Tables 3.4-5, modified, and 3.4-8, modified, are included in the 'Tabulated Area Source Data' file on tape, as are area source process emissions, not printed in any table.

6/ Tables 5.1, 5.2, 3.5-2, and 3.5-6 were not produced for New Jersey because data were unavailable. For the same reason, the 'Tabulated Area Source Data' file as formatted and constructed for New Jersey does not contain these data.

-- All references to tape in items listed below refer to the 'Tabulated Area Source Data' file, the format of which is available:

items 18-20
item 23
items 25-32
item 35
item 37
items 41-43
items 45-47

-- Tables 2.4 and 2.5 have been excluded; Tri-State's fuel apportionment procedures are available in the Methodology Report.

-- Table 2.7 has been excluded because growth factors for fuel combustion were calculated uniquely for each sector of fuel demand:

1. residential growth, as explained in the Methodology Report, is based upon growth in dwelling units in specific building sizes as forecast by Tri-State's modelling techniques;
2. commercial/institutional growth factors, based on county employment change in this sector, are in the Methodology Report;
3. industrial growth factors, from OBERS as modified by Tri-State, are in the Methodology Report.

-- Table 3.1-2 has been excluded as irrelevant to the Tri-State methodology.

APPENDIX IV

METHOD OF ESTIMATING POPULATION, HOUSING UNITS, AND FLOOR SPACE

The purpose of this appendix is to indicate the sources of the estimated population, housing units, and non-residential floor space quantities that are involved so frequently in the methods for calculating pollutant emissions for this Inventory. Also to be indicated is how estimates for the various target years were derived from the main target date ("capacity") used in Tri-State land use planning.

Three Tri-State Interim Technical Reports, all included among the backup documentation, are necessary to explain the complicated planning operations involved in estimates. The basic one is ITR 4531-5401: The Land Development System for the Tri-State Region, an Overview, January 1976. This document explains the methods used in obtaining estimates employed in the Inventory. The Commission is currently revising the goals, objectives, criteria, and allocations of its plan (the Regional Development Guide, briefly described on page 17). But the inputs in this Inventory were those derived from the so-called 1972 plan; thus the processes described in the ITR above provide the pertinent explanations.

Housing

In this Inventory, 1974 baseline housing units were estimated by monitoring housing authorizations and adding them to the 1970 Census quantities. (See another backup report which illustrates this activity: ITR 4533-1210: 1974-1975 Housing Changes in the Tri-State Region, particularly Table 12, p. 24.) Yearly increments, originally collected by municipalities, are distributed to square miles (to be later "rotated" to mercator-oriented square kilometers, see Appendix I) by a computerized distributor.

Residential buildings by number of units (called "building size" for short) are also available from the yearly increments (see Table 4, p. 9). This parameter is important in another step in estimating housing, to be explained below.

Housing unit estimates for future years are functions of the land development model series. While a complete reading of ITR 4531 is desirable, the researcher may begin on page 24, where the "capacity" system is described. Especially important is the "density norm" for future residential development, explained on page 16 and mentioned as a model input on page 26. The residential routine (p. 27) yields the capacity measures of total housing units as well as the measure of the density (per square mile) for the data cell.

Population

Population estimates per square mile are basically a simple derivation from housing units obtained by applying a persons/household factor (page 24, V-1-a). But these in turn are modified by the officially determined "targets" set by the Commission in the Regional Development Guide after concurrence by subregions (see ITR 4509-1506), as well as the ratio of employment to population assigned to the relevant subregion (pp. 28-29, item 7).

Building Size. Conversion of total housing units to number of housing units in buildings of various sizes was accomplished through a semi-independent model, described in "Methodology and Analysis of the Tri-State Housing structure Type Model," Analysis Notes 3402, January 1975 (included among the back-up reports). Although the model is not regarded as a final answer, it is the best available system anywhere that is operable in such a large region.

The method used changes in building size distribution between 1960-1970 as a principal determinant in the calculation. Another principal determinant is the density of housing per square mile at capacity. This latter parameter is converted to the likeliest housing type by reference to a distribution matrix (p. 3).

The quantities contained in the reference were later changed, based on recalibration to the 1975 housing unit breakdowns obtained from the yearly monitoring activities referenced above. In other words, the model was adjusted to replicate the changes that had occurred between 1970 and 1975.

APPENDIX V

METHODS OF ESTIMATING EMPLOYMENT

A. Total Employment

As described in ITR 4531: The Land Development System (pp. 24 ff.), a nonresidential routine calculates nonresidential land at capacity, translates this to nonresidential floor area by the use of a density norm, and estimates jobs based on a floor area/worker ratio. These parameters are then adjusted by comparison to the employment/population ratios used for the respective subregions, which in turn are keyed to a regional employment control.

Quantities for intervening years were products of the Time Series operation (pp. 36 ff.). For this, employment totals were determined for the year 1974 and forecasted for the year 1985 and 2000. (See ITR 4509-1506, "Most Likely Targets for Planned Growth," January 1976, pp. 6-9). These forecasts were checked for reasonableness by reflecting them against an output productivity approach.

B. Industry Breakdowns of Employment

Certain calculations such as the numerous ones for fuel use required that breakdowns of employment related to categories of pollutant sources be available. These were: "Commercial/institutional" and "Industrial."

Since these are not standard employment breakdowns, they had to be reached through a series of accepted assumptions for re-grouping conventional breakdowns into the required categories.

Conventional Categories. One-digit establishment breakdowns of 1974 employment for each county formed the basis for distributing the 1985 and 2000 totals obtained previously. These were obtained routinely by Tri-State as part of its annual monitoring series. (See ITR 4545-1202: Regional and County Employment Monitoring: Year 1974, February 1976.)

These distribution factors were then applied to the county totals for 1980, 1985, and 2000 yielded by the Time Series operation. Distributed quantities were then balanced to conform with the distributed regional total for 1985 and 2000, obtained from a 1970 analysis of trends in one-digit SIC sectors from 1958 to 1968. In this analysis, proportions were extrapolated on the basis of shift-share analysis. Factors obtained were later applied to employment totals adopted by the Commission in 1976. (See ITR 4287-2501: "Regional Employment Projections by Major Industry.")

Pollution Source Categories. The remaining step was to re-group conventional categories into "commercial/institutional" and "industrial." This was accomplished through the use of a procedure as follows:

Industrial: Take 65% of manufacturing employment. This is the proportion of production workers in this sector.

Commercial/Insitutional: The following shares of relevant sectors were assembled:

- 100% of Agriculture and Mining (since most employment in these categories is at headquarters and office-type installations).

- 100% of Construction, since such jobs are not engaged in the production of goods.
- 35% of Manufacturing, the nonproduction residual.
- 100% of Finance, Insurance, and Real Estate.
- 85% of Services, since 15% are in the nonprofit categories.
- 97% of Wholesale and Retail Trade, thus allowing a small portion for production jobs.

Two special operations were also conducted. One was a distribution of industrial employment into two-digit categories related to emissions from processing operations. These were explained in the chapter on Industrial Processes, P 2/pp. 3-5. Another involved the geographical distribution of area source pollutants in the "commercial/institutional" and "industrial" categories by the use of nonresidential floor area files. This process is explained on page A 2a/5-6.

Work sheets showing intermediate data produced in these processes are available for inspection in the files of the Socio-Economic Development Section at Tri-State.

STATEWIDE FUEL BALANCE CALCULATIONS FOR 1974
NEW YORK STATE
(Obtaining County Totals From MIS State Totals)

The purpose of the following methodology is to provide county level heating fuel use estimates by user class for use in air quality maintenance planning. This work is a necessary part of developing the comprehensive emission inventory needed for air quality modeling. It should be noted that the numbers generated for a county are the total fuel use for that class for that county and thus include both point and area sources. To find the area source fuel use for a county, the point source fuel use (determined from the NYS DEC AIR-100 files) should be subtracted from the total fuel use.

The numbers generated by this methodology are consistent with the mineral industries survey of the Bureau of Mines, and with the fuels and electric energy consumed publication from the annual Survey of Manufacturers. However, with the exception of the natural gas use, they are mathematical derivations based upon the best available information. If the oil and coal fuel surveys presently underway by DEC receive sufficient response, they should be used for county totals, as they represent direct measurements rather than mathematical estimates.

(A) Start with mineral industry surveys 1974 fuel use in New York State (Use figures from the 1975 publications as they contain adjusted 1974 data).

FUEL TYPE	OIL x 1000 BBL (#1, 2, 4)	OIL x 1000 BBL (#5-6)	10^6 CF NATURAL GAS	COALS x 1000 TONS
HEATING OILS	86,406	51,880		
INDUSTRIAL USE OILS	2,462	8,551		
Residential Gas			341,032	
Commercial Gas			118,693	
Industrial Gas			108,542*	
BITUMINOUS COAL & LIGNITE				
Retail Dealers				72
All Others				2,058
ANTHRICITE COAL**				632
TOTALS	88,868	60,431	568,267	2,762

*Includes refinery fuel use and carbon black production.

**From New York State Public Service Commission.

(B) Get New York State industrial fuel use from the U.S. Department of Commerce 1974 Annual Survey of Manufacturers (ASM) Fuels and Electric Energy Consumed:

RAW NUMBERS: 8,129.0 x 1000 BBL Distillate Oil (#1, 2, 4)

14,810.8 x 1000 BBL Residual Oil (#5, 6)

2,243.1 x 1000 tons coal

(Disclosure)* x 1000 tons coke-use 1971 ASM # = 544.0 x 1000 tons

93.3 BCF gas

35.4 million dollars other

(Disclosure)* million dollars of "fuels not specified by kind"

*Disclosure means data withheld to avoid disclosing individual company data.

On page A-2 is the statement: "Some small establishments reported total cost of fuels but failed to report the cost and quantity of their specific fuels used. Estimates of their total cost of fuels are included in the tables, under the heading "Fuels, Not Specified By Kind." To the extent that the information on detailed fuels consumed was not obtained, the data shown for individual fuels in this report tend to be understated."

Also on Page XIV it states that natural gas used to produce carbon black is excluded.

In view of the above conditions on the reported data, two correction steps are necessary:

(1) The total industrial natural gas use should equal that determined by the NYS DEC fuel survey = 100,848 x 10^6 ft^3.

(2) The "Fuel Not Specified By Kind" (FNSK) must be apportioned among the other fuels. This can be done via Kilowatt hour equivalents. Certain assumptions are necessary.

   (a) FNSK does not include any coal or coke -- this makes sense as the ASM accounts for over 80% of the MIS coal used by all classes of users, and coke use is specialized.

   (b) FNSK contains all of the natural gas needed to make the ASM equal the NYS DEC fuel survey.

(c) The balance of FNSK is 50% distillate and 50% residual -- this reflects the fact that the smaller companies included in FNSK use less residual than the 65% residual used by companies included in the reported numbers.

Table 2.4 on Page XV gives the KWH equivalents for each fuel type. And, Table 3 gives the State total at 117.7 x 10^9 KWH.

Using the Table 2.4 values, the reported KWH equivalents are:

Distillate (8,129.7 x 1000 BBL)(1,707 KWH/BBL) = 13.88 x 10^9 KWH

Residual (14,810.8 x 1000 BBL)(1,842 KWH/BBL) = 27.28

Coal (2,243.1 x 1000 Tons)(7,677 KWH/Ton) = 17.09

Coke (544 x 1000 tons) (7,618 KWH/Ton) = 4.14

Gas (93.3 x 10^9 Ft^3)(303.3 KWH/$10^3 Ft^3$) = 28.30

Other (35.4 x $10^6$11)(168.6 KWH/11) = 5.97

96.66

State total KWH = 117.7 ---- 96.66 = 21.04 for FNSK.

GAS: ASM = 93.3, Need 100,848 so must have 7.548 BCF

this is 2.29 KWH

This leaves 21.04 -2.29 = 18.75 x 10^9 KWH for oil when this is split in half, need 9.375 x 10^9 KWH each of distillate and residual.

This yeilds: 9.375 x 10^9/1,707 = 5,492.1 x 1000 BBL distillate.

9.375 x 10^9/1,842 = 5,089.6 x 1000 BBL residual.

So use ASM AS: 5,492.1 + 8,129.0 = 13,621.8 x 1000 BBL distillate
5,089.6 + 14,810.8 = 19,900.4 x 1000 BBL residual

(C) Subtract New York State ASM adjusted fuel use from MIS

	x 1000 BBL DISTILLATE	x 1000 BBL RESIDUAL	x 1000 TONS COAL	x 1000 TONS COKE	BCF GAS (INDUSTRIAL)
MIS	88,868	60,431	2,762	-----	108.5
ASM	13,622	19,900	2,243	454	100.5
BALANCE	75,246	40,531	519	0	8.0 Ind - Carbon Blac

This balance plus the MIS residential and commercial gas use is all of the fuel left for other uses.

(D) Calculate Statewide residential fuel use by county.

(1) This is done by EPA's Volume 13 Order 3 method.

(2) Data is from New York State Detailed Housing Characteristics from the 1970 Census Publication HC(1)-B34..

(3) New households since 1970 are estimated from NYS Economic Development Board projections.

(4) Fuel use split in new households is the same as 1970 fuel use for 1971, 1972 and 1973. For 1974 on, 70% of new households are oil heated, 30% electric.

(5) The degree days for all counties in an SMSA are the same. All degree day data is from New York State Business Fact Books which get their data from weather bureau. A table of the degree days used for each county is in the Appendix.

(6) Detailed county level calculations are available in the Appendix.

(7) There is no attempt to split distillate oil from residual oil at this time.

(8) As agreed with George Kerr of USEPA on February 17, 1977, residential oil use for water heating by oil fired water heaters (reported in the Census of Housing) is estimated at 250 gal. per oil fired water heater per year. This water heating oil use is added to the space heating oil use calculated by the Volume 13 Order 3 method to get total residential oil use.

RESIDENTIAL FUEL USE

AREA	OILS (x 1000 BBLS) SPACE HEATING	WATER HEATING	GAS (BCF)	COAL (1000 TONS)
Albany SMSA	3,240	273.7	20.6	11.9
Montgomery County	226.7	12.9	1.7	3.6
Binghamton SMSA	------	------	------	------
(New York Part)	789	37.6	9.9	19.8
Buffalo SMSA	1,833	110.2	63.0	20.3
Rochester SMSA	2,492	75.8	30.3	28.7
Ontario County	256.1	3.1	2.6	3.5
Syracuse SMSA	1,130	34.4	25.2	17.4

AREA	OILS (x 1000 BBLS) SPACE HEATING	WATER HEATING	GAS (BCF)	COAL (1000 TONS)
Utica-Rome SMSA	1,240	41.5	9.6	16.3
Chautauqua County	162.5	3.1	7.7	3.1
Chemung County	124.3	3.5	4.9	1.9
Steuben County	245.6	8.9	3.7	7.2
New York City	28,582.3	10,184.5	89.0	264.2
Nassau County	7,075.3	1,752.2	9.7	5.1
Suffolk County	5,515.1	1,092.4	10.7	2.5
Rockland County	183.4	14.9	8.5	0.4
Westchester County	3,739.1	954	10.7	7.3
Orange County	1,084.9	114.3	4.8	7.0
Putnam County	479.6	65.7	0	0.2
Ulster County	1,036.8	120.9	0.9	2.7
Dutchess County	1,488.8	194.9	1.9	2.8
Balance of State	7,133.9	385.6	28.4	71.8
TOTALS	68,058	15,484.1	343.8	497.7

(E) Subtract these numbers from residential-commercial MIS balance.

	x 1000 BBL OILS	MMCF GAS (RESIDENTIAL)	x 1000 TONS COAL
MIS BALANCE	115,777	341,032	519
RESIDENTIAL CALCULATIONS	68,058	343,800	498
	47,719	- 2,770 = 0	21
OIL WATER HEATING	-15,484		
	32,235		

New York State Fuel Survey gas is 330,482 or 96.9% of MIS, so use New York State Fuel Survey for residential gas distribution.

(F) This balance is: Statewide commercial-governmental-institutional fuel use.

(1) MIS says commercial gas is 118.7 BCF; New York State Fuel Survey gives 113.3 BCF or 95.45% of MIS. Use New York State Fuel Survey numbers for commercial gas distribution.

(2) The 21,000 tons of coal is a negligible contributor to the total BTU's in this balance. No attempt will be made to allocate it. Rather, coal will be placed from the NYS DEC AIR-100 file.

(3) New York City Department of Air Resources data gives New York City steam generation fuel use as:

409,921,000 gallons #6 oil

77,000 gallons #2 oil

4,972,000 MCF gas

The output BTU equivalents are:

#6 oil $409{,}921 \times 10^3$ gal. x 147×10^3 BTU/gal x .75 HPE = $45{,}193.8 \times 10^9$ BT

#2 oil 77×10^3 gal. x 144×10^3 BTU/gal x .75 HPE = 8.3×10^9 BTU

gas 4.972×10^9 Ft^3 x 800 BTU/Ft^3 x .80 HPE = $\underline{3{,}182.1 \times 10^9}$ BTU

TOTAL STEAM HEAT

These numbers would not be in MIS heating fuel numbers: $48{,}384.2 \times 10^9$ BTU's

(4) The MIS balance contains the following output BTU's:

$32{,}235 \times 10^3$ BBL oil x 42 gal/BBL x 145×10^3 BTU/BBL x .75 HPE = $147{,}233 \times 10^9$

$113.3 \times 10^9 Ft^3$ gas x 800 BTU/Ft^3 x .8 HPE = = $72{,}512 \times 10^9$

$219{,}745 \times 10^9$

(5) Adding New York City steam $48{,}384 \times 10^9$ BTU's gives total commercial-institutional-government heat use of $268{,}129 \times 10^9$ BTU

(6) Assume:

(a) Fuel use is related to employment.

(b) Fuel use per employee is related to degree days.

(c) Fuel use per employee is inversely related to density of development (as is true for residential).

(7) To obtain the heating requirement per employee:

(a) Find total commercial-government-institutional employment for each area. This is from the 1974 data in the New York State Business Fact Book, 1976 supplement. The categories of employment included are: Transportation, public utilities; wholesale, retail trade; finance, insurance, real estate; services and miscellaneous; government.

(b) Generate a degree day and density factor for each area. For this analysis, the relative fuel requirement (RFR) factors generated for residential use were used for density, as the resources to estimate relative commercial densities did not exist. The RFR's were then multiplied by the degree days for an area. In order to simplify future calculations, this RFR times degree days number was divided by the New York City RFR times degree day number to get factors ranging from 1.0 to 1.675. These factors indicate the relative heating fuel requirements per employee for the different areas of the State.

(c) Multiply the commercial employment for an area found in (a) by its relative heating fuel requirement per employment found in (b) to get an area's heating fuel equivalent employment.

(d) Sum the heating fuel equivalent employments found in (c) to obtain a statewide heating fuel equivalent employment.

(e) Divide the total commercial heat (from Step F-5) by the heating fuel equivalent employment found in (d) to get total heat per equivalent employee (the number obtained is 43.59×10^6 BTU's/employee).

(8) Multiply the heating requirements per employee (from F-7(e)) by each area's equivalent employment (from F-7(c)) to get the heating requirement for a county or SMSA.

(9) To find the fuel mix for an area:

(a) Subtract New York City steam BTU's from the New York City total BTU's.

(b) Subtract the gas BTU's from the NYS DEC fuel survey from the appropriate county heating requirements.

(c) The remaining BTU's in an area are oil -- convert to gallons and 1000 BBLS.

(10) The calculations are on the next two tables:

AREA	EMPLOYEES (x 1000) 1974	RFR * DD FACTOR	EQUIVALENT EMPLOYMENT	NECESSARY BTU'S $\times 10^9$	— NYC STEAM BTU'S $\times 10^9$	FUEL SURVEY —GAS BTU'S $\times 10^9$
New York State Tot.	5,238.7	1.174	6,151.2	268,129		
New York City	2,742.6	1.00	2,742.6	119,549	48,384	19,136
Nassau-Suffolk	610.3	1.05	640.8	27,932		6,010
Westchester	228.4	1.05	239.8	10,453		3,200
Rockland	54.9	1.05	57.6	2,511		2,399
Dutchess	54.1	1.05	56.8	2,476		744
Rochester (5 Co.)	226.1	1.578	356.8	15,553		7,395
Syracuse SMSA	170.1	1.565	266.2	11,604		6,456
Elmira SMSA	23.2	1.670	38.7	1,687		1,544
Utica-Rome	74.6	1.578	117.7	5,131		2,045
Buffalo SMSA	327.6	1.563	512.0	22,318		5,734
A-S-T (5 County)	232.5	1.616	375.7	16,377		4,386
Steuben	18.2	1.67	30.4	1,325		962
Chautauqua	31.2	1.60	49.9	2,175		864
Putnam	8.8	1.05	9.2	401		0
Orange	52.0	1.05	54.6	2,380		1,298
Ulster	32.9	1.05	34.5	1,504		229
Binghamton	52.8	1.675	88.4	3,853		2,138
Balance	298.4	1.607	479.5	20,901		7,974

New York State equivalent employment is 6,151,200
New York State commercial-institutional-government BTU's are $268{,}129 \times 10^9$.

Thus, BTU's/Employee $= \dfrac{268{,}129 \times 10^9}{6{,}151.2 \times 10^3} = 43.59 \times 10^6$ BTU's/ equivalent employee

NOTE: Gas BTU's = Ft^3 gas * 800 BTU's/Ft^3 x .8 HPE = 640 BTU/Ft^3

AREA	x 10^9 OIL BTU'S	OIL MGAL	OIL x 1000 BBL
New York State Total			32,235
New York City	52,029	478,428	11,391
Nassau-Suffolk	21,922	201,582	4,800
Westchester	7,253	66,694	1,588
Rockland	112	1,030	25
Dutchess	1,732	15,926	379
Rochester (5 County)	8,158	75,016	1,786
Syracuse (SMSA)	5,148	47,338	1,127
Elmira (SMSA)	143	1,315	31
Utica-Rome (SMSA)	3,086	28,377	676
Buffalo (SMSA)	16,584	152,497	3,631
A-S-T (5 County)	11,991	110,262	2,625
Steuben	363	3,338	79
Chautauqua	1,311	12,055	287
Putnam	401	3,687	88
Orange	1,082	9,949	237
Ulster	1,275	11,724	279
Binghamton	1,715	15,770	375
Balance	12,927	118,869	2,830

NOTE: 10^9 BTU's = 9,195 gallons oil @ HPE .75 and 145,000 BTU/gal.

1 BBL = 42 gal. and 1000 BBL = 42 MGAL oil

(G) Split of distillate vs residual for residential and commercial.

(1) For New York City commercial, NYC-DAR estimates give 67,340 MGAL #2 + 24,337 MGAL #4 + 292,754 MGAL #6 = 384,431 MGAL.

DEC calculations give New York City 478,428 MGAL of oil or 124.5% of NYC-DAR.

Therefore, assume NYC-DAR split is correct and multiply each entry by 1.2445.

This gives New York City commercial

#2 83,805 MGAL
#4 30,288 MGAL > 2,717 x 1000 BBL distillate

#6 364,332 MGAL = 8,675 x 1000 BBL residual

(2) Similarly for residential in New York City

(a) New York City Division of Air Resources gives:

755,959 MGAL #2 + 299,813 MGAL #4 + 1,516,615 MGAL #6 = 2,572,387 MGAL

(b) New York State Department of Environmental Conservation gives:

1,628,206 MGAL = .63222 of DAR.

(c) Use NYC-DAR split on NYS-DEC number to get the following estimates:

477,931 MGAL #2
189,547 MGAL #4 > 15,892 x 1000 BBL distillate

958,831 MGAL #6 = 22,829 x 1000 BBL residual

(d) Thus, New York City residential-commercial accounts for the following amounts of residual oil.

22,879 residential
8,675 commercial
31,504 x 1000 BBL

(3) From Step C we know that there are 40,531 x 1000 BBL of residential-commercial residual oil.

Taking out New York City numbers we get for balance of state:

	DISTILLATE	RESIDUAL
From Step C	75,246	40,531
New York City Above	18,609	31,504
BALANCES	56,637	9,027

(4) The New York State AIR-100 inventory contains:

5,137.4	x 1000 BBL commercial residual
904.4	x 1000 BBL residential residual
6,041.8	x 1000 BBL residual

(5) (a) This leaves 9,027 — 6,042 = 2,985 x 1000 BBLS residual oil unaccounted for.

This is 5.0% of the available non-specified oils.

(b) So far commercial is $5,137 + 8,675 = \frac{13,812}{32,235}$ residual

= 42.85 residual.

and residential is $\underline{904 + 22,829} = \frac{23,733}{83,542}$

= 28.40% residual.

(c) The unaccounted-for residual is 8% of the known residential and commercial residual. There are a number of equally indefensible ways to distribute this oil, including:

(1) Give it all to New York City as DEC has only 31,504 out of NYC-DAR's estimated 43,080 x 1000 BBLS of redisual oil.

(2) Distribute it around the State in proportion to "known" residual oils.

(3) Give half to commercial, half to residential -- let residential follow buildings of 20 units/structure, let commercial follow areas with commercial residual use, where less than 50% of commercial oil is residual.

(4) Many others.

(d) It is important to remember that we are talking of only 2.0% of the State's heating oil use and 2.6% of the State's commercial residential heating oil use.

(e) Methods 1 and 2 in Step G-5c will give additional residual oil to New York City while Method 3 will not.

Method 1 will give no new residual oil to places outside of New York City, yet we know DEC's inventory is not perfect.

Therefore, Method 2 was chosed. The residual oil in each county from the AIR-100 file and New York City DAR estimates as modified was increased by 8% (actually 7.9%).

(f) The results of all of these manipulations on the missing 2.6% of commercial/residential fuel are presented on the following tables. This gives New York City 2,516/2,997 = 83.95% of the unallocated residual oil.

ESTIMATED RESIDENTIAL FUEL USE IN NEW YORK STATE

AREA	X 1000 BBL DISTILLATE OIL	X 1000 BBL RESIDUAL OIL	CALCULATED GAS (BCF)	FUEL SURVEY (BCF) GAS	X 1000 TONS COAL
New York City	14,123	24,644	89.0	93.3	264.2
Nassau	8,303	524	9.7	14.2	5.1
Suffolk	6,607	0	10.7	12.6	2.5
Rockland	197	1	8.5	10.0	0.4
Westchester	4,375	318	10.7	14.6	7.3
Orange	1,199	0	4.8	4.2	7.0
Putnam	540	5	0	0	0.2
Ulster	1,158	0	0.9	0.7	2.7
Dutchess	1,684	0	1.9	1.3	2.8
Albany (SMSA)	3,478	36	20.6	16.8	11.9
Montgomery County	240	0	1.7	1.1	3.6
Binghamton (SMSA) New York Part	827	0	9.9	7.6	19.8
Buffalo SMSA	1,868	75	63.0	60.9	20.3

AREA	X 1000 BBL DISTILLATE OIL	X 1000 BBL RESIDUAL OIL	CALCULATED GAS (BCF)	FUEL SURVEY (BCF) GAS	X 1000 TONS COAL
Rochester SMSA	2,568	0	30.3	27.2	28.7
Ontario County	259	0	2.6	2.3	3.5
Syracuse SMSA	1,147	17	25.2	20.9	17.4
Utica-Rome SMSA	1,281	0	9.6	9.1	16.3
Jamestown-Chautauqua	166	0	7.7	3.2	3.1
Elmira-Chemung Steuben	382	0	8.6	7.6	9.1
Balance of State	7,520	0	28.4	22.8	71.8
State Totals	57,922	25,620	343.8	337.4	497.7

Inventory residual x 1.1008 is entered on the chart below and the distillate (= total − residual) is calculated. The results are total commercial-institutional fuel/county presented below:

COMMERCIAL-INSTITUTIONAL-GOVERNMENT FUEL USE BY AREA

AREA	DISTILLATE OIL	RESIDUAL OIL	BCF GAS
New York City	1,979	9,412	29.9
Nassau-Suffolk	4,068	732	9.4
Westchester	1,178	410	5.0
Rockland	0	34* (or 25)	3.7
Dutchess	174	205	1.2
Rochester (5 County)	1,394	392	11.6
Syracuse (SMSA)	849	278	10.1
Elmira (SMSA)	0	46* (or 31)	2.4
Utica-Rome (SMSA)	544	132	3.2
Buffalo (SMSA)	2,798	833	9.0
A-S-T (5 County)	1,822	803	6.9
Steuben	74	5	1.5
Chautauqua	287	0	1.4
Putnam	80	8	0
Orange	185	52	2.0
Ulster	210	69	0.4
Binghamton	318	57	3.3
Balance	1,388	1,442	12.5
	17,348	14,910	113.5

*For Rockland and Chemung Counties, the calculated commercial oil use is less than the AIR-100 file residual oil use. The higher number is the AIR-100 number, while the lower number is the calculated oil use. When these areas are analyzed, some decision will have to be made on how to handle this difference.

(H) (1) We have now allocated:

Distillate oil
Residual oil
Natural gas

To county for residential, and commercial-institutional-government

(2) Using the AIR-100 file for residual oil, we can physically locate over 90% of the residual oil within each county except New York City. The remaining residual oil in a county will have to be considered an uncontrolled area source lumped in with the distillate oil users.

(I) For industrial fuel use:

(1) We can obtain SMSA level data for 1974 from the fuels and electric energy consumed publication. This SMSA level data will have to be adjusted for the fuels not specified by kind (FNSK). Then, this data will have to be used with DEC's AIR-100 data NYC-DAR industrial fuel use estimates to adjust certain AIR-100 entries so that the inventory contains no more fuel in an SMSA than is actually available.

APPENDIX A

DEGREE DAYS USED IN FUEL BALANCE CALCULATIONS
AND
MORE DETAILED NEW YORK SMSA DATA SECURED SINCE CALCULATIONS

AREA	DEGREE DAYS USED	MORE DETAILED INFORMATION	
ALBANY SMSA			
Albany	7,462		
Rensselaer	7,462		
Montgomery	7,462		
Saratoga	7,462		
Schenectady	7,462		
BINGHAMTON SMSA			
Broome	7,654		
Tioga	7,654		
BUFFALO SMSA			
Erie	7,364		
Niagara	7,364		
NEW YORK SMSA			
Bronx	5,916		
Kings	5,916	Central Park	5,916
New York	5,916	JFK Airport	6,045
Queens	5,916	La-Guardia	5,957
Richmond	5,916		
Nassau	5,916	Mineola	6,010
Suffolk	5,916	Bridgehampton	6,106
		Patchogue	6,309
		Riverhead	6,047
		Setauket	5,908
Putnam	5,916	Carmel	6,909
Rockland	5,916		
Westchester	5,916	Scarsdale	6,192
		Bedford Hills	6,496

AREA	DEGREE DAYS USED	MORE DETAILED INFORMATION
ROCHESTER SMSA		
Livingston	7,250	
Monroe	7,250	
Ontario	7,250	
Orleans	7,250	
Wayne	7,250	
SYRACUSE SMSA		
Madison	7,229	
Onondaga	7,229	
Oswego	7,229	
UTICA-ROME		
Herkimer	7,220	
Oneida	7,220	
ALL OTHERS (Guess)	7,200	

APPENDIX B

Detailed county level residential fuel use estimates for fuel balance calculations. These calculations follow the Volume 13 Order 3 residential method of the EPA guidelines for air quality maintenance planning and analysis.

The Volume 13 Order 3 Method, (Called the Method in the rest of this Appendix) is based upon:

(1) That the average heating requirement for a single family detached dwelling unit is 17,000 BTU/degree day.

(2) That more densely developed dwellings (i.e., duplexes, apartments) require less heat per unit due to the lower number of outside walls per unit, and smaller average size.

(3) An average heating plant efficiency and fuel heat content for each type of fuel.

It is obvious that this method will do a poor job of predicting fuel use for a single randomly selected dwelling unit, as it does not take into account important variables such as: insulation, storm windows, heating plant maintenance, size of dwelling, number of windows, temperature preferences, etc. However, for a city or county, the Method will give reasonable results.

The specific steps involved in using this Method are:

(A) Find the number of equivalent single family units for the area in question. This number is simply the sum of number of units of a given type times the relative fuel requirement for that type of unit.

Due to lack of data, some assumptions were necessary.

(1) Assume that the number of units in buildings over four stories with elevators represents the number of units in buildings of over fifty (50) dwelling units.

(2) Assume that the relative fuel requirements for buildings of 5 to 19 units is the average of the relative fuel requirements for buildings of 5 to 9 units and 10 to 19 units.

With these assumptions the following formula for determining equivalent single family dwellings for coal and oil heated units emerges.

Equivalent S.F. Units = 1.0 x No. single family units.
+ 0.9 x #2-4 family units
+ 0.73 x #5-19 family units
+ 0.57 x (#20+ family units — # in 4+ story buildings with elevators)
+ 0.51 x # units in 4+ story buildings with elevators

The equation for gas heated units is similar, except:

The 0.73 is changed to 0.69
The 0.57 is changed to 0.49
The 0.51 is changed to 0.44

(B) Once the number of equivalent single family units for an area is determined, it is divided by the total number of units in the area to get a composite area-wide relative fuel requirement. This is done for both gas, and coal-oil.

(C) From the 1970 Census, determine the number of housing units in an area heated with: oil, gas, coal and electricity. Also, determine the fraction of the total gas, oil and electric housing units heated with each type of fuel in 1970.

(D) From the New York State Economic Development Board projections, find the number of new households created between 1970 and 1975 for each area.

(E) In order to make the fuel split assumed for this growth in the body of this document (i.e., 71, 72, 73 at 1970 fuel split, 74, 75 at 70% oil, 30% electric), the 1970 fuel split percentages for only gas, oil and electric obtained in (C) should be multiplied by 0.6 (for 3 out of 5 years), 28% added to the oil number and 12% added to the electric number.

For Example: 70 to 75 oil % = (1970 oil %) x (0.6) + 28%

70 to 75 electric % = (1970 electric %) x (0.6) + 12%

70 to 75 gas % = (1970 gas %) x (0.6)

The resulting percentages can be applied to the growth found in (D) to obtain new housing units by fuel type by area for 1970 to 1975.

(F) The new housing units by fuel type from (E) are added to the 1970 housing units by fuel type found in (C) to obtain 1975 housing units by fuel type.

(G) Assume that the RFR for this growth is the same as the RFR for the 1970 housing units calculated in (B).

(H) The space heating fuel use for the area is calculated from the following formula:

Area fuel use = (# units with heating fuel type) x (RFR for fuel type) x (Degree days for area) x (Fuel use factor)

The fuel use factors are simply the amount of fuel at the assumed heating plant efficiency required to produce 17,000 BTU's of heat output. They are:

Coal	2.38 lbs.
Oil	0.157 gal.
Gas	26.6 cubic feet

(I) Significant results for selected areas are presented in the following tables.

AREA	1970 TOTAL UNITS	OIL-COAL EQUIVALENT S.F. UNITS	GAS EQUIVALENT S.F. UNITS	COAL-OIL RFR	GAS RFR
Bronx	508,649	324,900	297,014	.63875	.58393
Kings	902,236	675,226	646,297	.74839	.71633
New York	714,371	416,723	372,541	.58334	.52150
Queens	703,154	551,671	532,585	.78457	.75742
Richmond	89,289	80,375	79,517	.90017	.89056
New York City	2,917,699	2,048,895	1,927,954	.70223	.66078
Nassau	407,416	388,027	385,576	.9524	.9463
Suffolk	313,489	306,946	306,172	.9791	.9766
Rockland	62,167	58,224	57,715	.9366	.9284
Westchester	290,377	245,143	239,265	.8442	.8240
Orange	71,665	68,066	67,756	.9498	.9455
Putnam	19,017	18,601	18,563	.9781	.9761
Ulster	50,286	48,446	48,290	.9634	.9603
Dutchess	67,962	65,972	65,547	.9707	.9645
Albany	98,073	91,297	90,747	.9309	.9253
Montgomery	20,006	18,803	18,746	.9399	.9370
Rensselaer	49,568	46,241	45,999	.9329	.9280
Saratoga	38,268	36,934	36,841	.9651	.9627
Schenectady	55,387	52,120	51,881	.9410	.9367
Broome	72,825	68,216	67,802	.9367	.9310
Tioga	14,058	13,745	13,730	.9777	.9767
Erie	359,384	335,069	333,492	.9323	.9280
Niagara	74,085	70,932	70,584	.9574	.9527

AREA	1970 TOTAL UNITS	OIL-COAL EQUIVALENT S.F. UNITS	GAS EQUIVALENT S.F. UNITS	COAL-OIL RFR	GAS RFR
Livingston	16,119	15,692	15,657	.9735	.9713
Monroe	227,900	212,140	210,444	.9308	.9234
Ontario	24,803	23,899	23,820	.9636	.9604
Orleans	12,204	11,905	11,884	.9755	.9738
Wayne	24,475	23,886	23,852	.9759	.9745
Madison	18,873	18,301	18,261	.9697	.9676
Onondaga	152,017	140,095	138,787	.9216	.9130
Oswego	30,926	30,021	29,949	.9707	.9684
Herkimer	23,173	22,249	22,189	.9601	.9575
Oneida	86,311	80,938	80,516	.9377	.9329
Chemung	32,964	31,619	31,524	.9592	.9563
Steuben	33,065	32,126	32,076	.9716	.9701
Chautauqua	51,374	49,433	49,321	.9622	.9600

GROWTH FROM 1970 TO 1975
(HOUSEHOLDS)

AREA	TOTAL GROWTH	NEW OIL	NEW GAS	NEW ELECTRIC
New York City	26,000	17,700	4,870	3,430
Nassau	9,000	7,030	880	1,090
Suffolk	46,000	34,280	6,170	5,550
Rockland	10,000	3,360	5,430	1,210
Westchester	12,000	8,420	2,110	1,470
Orange	9,000	5,730	2,110	1,160
Putnam	4,000	3,520	0	480
Ulster	7,000	5,660	460	880
Dutchess	7,000	5,480	660	860
Albany	6,000	3,330	1,870	800
Montgomery	1,000	560	300	140
Rensselaer	4,000	2,526	937	537
Saratoga	8,000	5,029	1,829	1,142
Schenectady	2,000	1,105	631	264

AREA	TOTAL GROWTH	NEW OIL	NEW GAS	NEW ELECTRIC
Broome	3,000	1,335	1,274	391
Tioga	1,000	721	140	139
Erie	17,000	5,688	9,170	2,142
Niagara	6,000	3,430	1,884	686
Livingston	1,000	559	290	151
Monroe	12,000	5,564	4,775	1,661
Ontario	3,000	1,520	1,080	400
Orleans	1,000	659	201	140
Wayne	1,000	594	272	134
Madison	1,000	625	243	132
Onondaga	11,000	4,156	5,287	1,557
Oswego	4,000	2,200	1,250	550
Herkimer	2,000	1,211	522	267
Oneida	4,000	2,080	1,198	722
Chemung	2,000	723	1,020	257
Steuben	2,000	922	824	254
Chautauqua	3,000	1,045	1,573	382

CALCULATED 1975 RESIDENTIAL SPACE HEATING FUEL USE

AREA	FUEL	UNITS USING FUEL IN 1975	RELATIVE FUEL REQUIREMENTS	DEGREE DAYS	FUEL USE*
New York City	Oil	1,840,510	.70223	5,916	28,582.2
	Gas	855,477	.66078	5,916	88,956
	Coal	53,448	.70223	5,916	264.2
Nassau	Oil	335,925	.9524	5,916	7,075.2
	Gas	65,222	.9463	5,916	9,712
	Coal	764	.9524	5,916	5.1
Suffolk	Oil	254,713	.9791	5,916	5,515.1
	Gas	69,670	.9766	5,916	10,707
	Coal	363	.9791	5,916	2.5

AREA	FUEL	UNITS USING FUEL IN 1975	RELATIVE FUEL REQUIREMENTS	DEGREE DAYS	FUEL USE*
Rockland	Oil	3,853	.9366	5,916	183.4
	Gas	58,429	.9284	5,916	8,536
	Coal	67	.9366	5,916	0.4
Westchester	Oil	200,283	.8442	5,916	3,739.1
	Gas	82,188	.8240	5,916	10,657
	Coal	1,231	.8442	5,916	7.3
Orange	Oil	42,439	.9498	7,200	1,084.9
	Gas	26,241	.9455	7,200	4,752
	Coal	861	.9498	7,200	7.0
Putnam	Oil	18,057	.9781	7,200	475.3
	Gas	0	.9761	7,200	0
	Coal	22	.9781	7,200	0.2
Ulster	Oil	39,983	.9634	7,200	1,036.7
	Gas	4,752	.9603	7,200	874
	Coal	329	.9634	7,200	2.7
Dutchess	Oil	55,454	.9707	7,200	1,448.8
	Gas	10,073	.9645	7,200	1,861
	Coal	341	.9707	7,200	2.8
Albany	Oil	45,533	.9309	7,462	1,182.3
	Gas	49,714	.9253	7,462	9,131.
	Coal	352	.9309	7,462	2.9
Montgomery	Oil	8,961	.9399	7,462	234.9
	Gas	9,403	.9370	7,462	1,749
	Coal	451	.9399	7,462	3.8
Rensselaer	Oil	29,319	.9329	7,462	762.9
	Gas	18,791	.9280	7,462	3,461.
	Coal	492	.9329	7,462	4.1
Saratoga	Oil	24,846	.9651	7,462	668.9
	Gas	14,824	.9627	7,462	2,833
	Coal	224	.9651	7,462	1.9
Schenectady	Oil	24,878	.9410	7,462	653
	Gas	28,139	.9367	7,462	5,232
	Coal	377	.9410	7,462	3.2
Broome	Oil	19,758	.9367	7,654	529.5
	Gas	48,728	.9310	7,654	9,236
	Coal	1,486	.9367	7,654	12.7

AREA	FUEL	UNITS USING FUEL IN 1975	RELATIVE FUEL REQUIREMENTS	DEGREE DAYS	FUEL USE*
Tioga	Oil	9,615	.9777	7,564	270.0
	Gas	2,961	.9767	7,654	589
	Coal	821	.9777	7,654	7.3
Erie	Oil	36,685	.9323	7,364	941.5
	Gas	315,482	.9280	7,364	57,348
	Coal	1,180	.9323	7,364	14.8
Niagara	Oil	36,639	.9574	7,364	965.6
	Gas	37,635	.9527	7,364	7,023
	Coal	727	.9574	7,364	6.1
Livingston	Oil	7,201	.9735	7,250	190.0
	Gas	7,209	.9713	7,250	1,350
	Coal	248	.9735	7,250	2.1
Monroe	Oil	71,429	.9308	7,250	1,801.9
	Gas	147,449	.9234	7,250	26,257
	Coal	2,240	.9308	7,250	18.0
Ontario	Oil	9,891	.9636	7,250	258.3
	Gas	14,328	.9604	7,250	2,654
	Coal	428	.9636	7,250	3.6
Orleans	Oil	7,318	.9755	7,250	193.5
	Gas	3,729	.9738	7,250	700
	Coal	470	.9755	7,250	4.0
Wayne	Oil	12,079	.9759	7,250	319.5
	Gas	10,223	.9745	7,250	1,921
	Coal	584	.9759	7,250	4.9
Madison	Oil	10,261	.9697	7,229	268.9
	Gas	7,028	.9676	7,229	1,308
	Coal	524	.9697	7,229	4.4
Onondaga	Oil	7,763	.9216	7,229	193.3
	Gas	118,687	.9130	7,229	20,837
	Coal	1,145	.9216	7,229	9.1
Oswego	Oil	14,587	.9707	7,229	382.6
	Gas	15,588	.9684	7,229	2,903
	Coal	504	.9707	7,229	4.2
Herkimer	Oil	12,239	.9601	7,220	317.1
	Gas	9,376	.9575	7,220	1,724
	Coal	492	.9601	7,220	4.1

AREA	FUEL	UNITS USING FUEL IN 1975	RELATIVE FUEL REQUIREMENTS	DEGREE DAYS	FUEL USE*
Oneida	Oil	36,483	.9377	7,220	923.3
	Gas	44,119	.9329	7,220	7,905
	Coal	1,518	.9377	7,220	12.2
Chemung	Oil	4,823	.9592	7,200	124.5
	Gas	26,722	.9563	7,200	4,965
	Coal	234	.9592	7,200	1.9
Steuben	Oil	9,423	.9716	7,200	246.4
	Gas	20,189	.9701	7,200	3,751
	Coal	867	.9716	7,200	7.2
Chautauqua	Oil	6,282	.9622	7,200	162.7
	Gas	41,846	.9600	7,200	7,694
	Coal	591	.9622	7,200	4.9

*Oil in 1000 BBL, gas in million cubic feet, coal in 1000 tons

(J) For oil, the amount of fuel used in water heating was calculated as 250 gallons/year per oil water heater. The 250 gallons/year is from Volume 7 of the guidelines. This adjustment is necessary because the Volume 13 Level 3 method for calculating oil space heating fuel use appears to exclude the fuel used for water heating.

TOTAL OIL REQUIREMENTS FOR SELECTED AREAS

AREA	SPACE HEATING x 1000 BBL	WATER HEATING x 1000 BBL	TOTAL x 1000 BBL
New York City	28,582.2	10,184.5	37,985.1
Nassau	7,075.2	1,752.2	8,827.4
Suffolk	5,515.1	1,092.4	6,607.5
Rockland	183.4	14.9	198.3
Westchester	3,739.1	954.0	4,693.1
Orange	1,084.9	114.3	1,199.2
Putnam	475.3	65.7	541.0
Ulster	1,036.7	120.9	1,157.6
Dutchess	1,448.8	194.9	1,643.7
Albany	1,182.3	113.5	1,295.8
Montgomery	234.9	12.9	247.8
Rensselaer	762.9	70.2	833.1
Saratoga	668.9	32.8	701.7
Schenectady	653.0	57.2	710.2

AREA	SPACE HEATING x 1000 BBL	WATER HEATING x 1000 BBL	TOTAL x 1000 BBL
Broome	529.5	25.9	555.4
Tioga	270.0	11.7	281.7
Erie	941.5	34.8	976.3
Niagara	965.6	75.4	1,041.0
Livingston	190.0	3.6	193.6
Monroe	1,801.9	63.7	1,865.6
Ontario	258.3	3.1	261.4
Orleans	193.5	2.4	195.9
Wayne	319.5	6.1	325.6
Madison	268.9	5.0	273.9
Onondaga	193.3	21.5	214.8
Oswego	382.6	7.9	390.5
Herkimer	317.1	9.6	326.7
Oneida	923.3	31.9	955.2
Chemung	124.5	3.5	128.0
Steuben	246.4	8.9	255.3
Chautauqua	162.7	3.1	165.8

CREDITS

Co-Managers of the project for Tri-State Regional Planning Commission were Hall Winslow, AIP, Coordinator, Environment Studies and Paul M. Nutkowitz, Ph.D., Senior Environmental Planner. Kenneth A. Skipka, Meteorologist, provided analytical and other contributions.

Data Processing Coordinator was Jocelyn M. Bishop. Assisting with processing were Roger Ann Connolly, Jerome Davis, Dennis Price, and Thomas Quinn. Conversion of square mile data to square kilometer format was designed by William Harting and Jocelyn M. Bishop.

Population and employment projections for target years were provided by the Regional Development Division based on most likely targets for the year 2000 approved by the Commission, January 1976.

Cooperation and data inputs are acknowledged from the air resources staffs of Connecticut, New Jersey, New York, and New York City.

Tri-State staff credits for specific elements are as follows:

Element		
A 1-4 P 2	Fuel Combustion) Industrial Processing)	Dr. Paul M. Nutkowitz
A 6	Diesel Locomotives	S. David Phraner Joseph Kanell, John Scott, Technicians
A 7	Aircraft	Valentin Mantulin Patricia Miller, Technician
A 8	Vessels	Olga B. Kean John Scott, Technician
A 9	Gasoline and Diesel - Highway	J. David Jordan Michael Cohen, John Berdan
A 9 b A 10	Gasoline and Diesel - Offhighway) Evaporation)	Larry S. Reep Elizabeth Phifer, Technician
A 11	Apartment Construction	Richard A. Hansen
P 1	Electric Power Plants	Robert A. Leighton
P 2	Industrial Output Projections	Ik Sun Kim
P 3	Municipal Incinerators	Kenneth J. Skipka Dr. Paul M. Nutkowitz

Report Preparation: Hannah Meyer

This draft report is presented in partial fulfillment of the requirements under EPA Contract No. : 68-02-2096 ; EPA-902/4-77-006.